Tree Assessment on Vacant Lots

Ohio State University SP22 AEDE 4567 Capstone

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Abstract and Methods

For our senior capstone project, which took place from January to April 2022, our team partnered with Green Columbus to assess trees on vacant lots. Our project's main goal was to find suitable recommendations for vacant lot tree maintenance. Our team conducted research including finding background information on the Urban Heat Island (UHI) effect and ecosystem benefits of trees, finding case studies of different cities' tree and vacant lot maintenance and policies, and looking at the City of Columbus's budget for maintenance. We also interviewed those who are knowledgeable on the subject and conducted vacant lot surveys through Google Earth of over 100 vacant lots in Central Ohio. We hope to advise Green Columbus, other community-based organizations, and the City of Columbus on how to effectively manage this natural resource for city and community benefit.

Introduction and Overview

https://www.greencbus.org

Green Columbus, a non-profit in Columbus, OH, identified a need for increased tree canopy and effective communication to protect trees in Central Ohio after an incident that occurred in one of their tree nurseries. After a storm swept through the area, the large tree on the property was damaged, leaving a branch from the tree broken. A member of Green Columbus contacted the City in hopes of getting the damaged branch removed from the property. Due to some miscommunication either by the City or the contractors in charge of removing the branch, the whole tree was cut down and left on the property. The loss of this tree meant the loss of shade, where volunteers could rest, place their tools, and the young trees could have respite from the sun. Trees hold many benefits to a property and a community, and our project and research have identified ecosystem services trees provide. In addition, our project looked at case studies of cities that have made an effort to increase urban tree canopy and protect trees in a city setting. With these case studies of maintenance plans, policies, and budgeting, we hope to advise the City of Columbus, Green Columbus, and other community-based organizations on how to effectively manage this natural resource for city and community benefit.

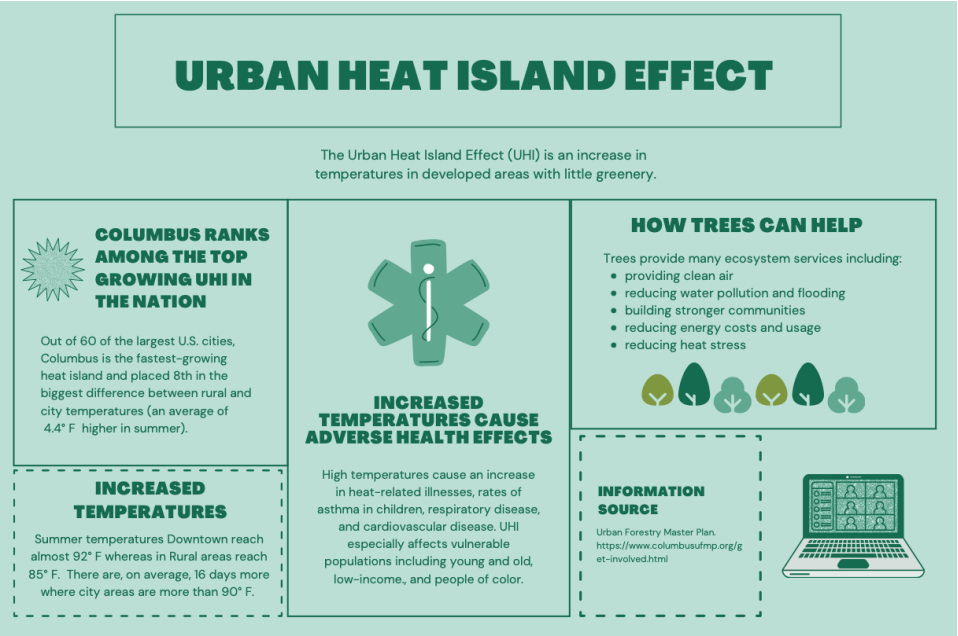
Engineers Without Borders partnership with Green Columbus, image taken at Hilltop Tree Nursery 2021 https://globalwater.osu.edu/engineers-without-borders-continues-partnership-with-green-columbus/

In previous years, funding and lack of communication have left trees in the city at the back of people's minds and priority lists. The last extensive tree assessment in Columbus was done in the 1970s. However, community and city interest has pushed for more organization and an increase of trees, thus the creation of the Columbus Urban Forestry Master Plan. The Columbus Urban Forestry Master Plan (UFMP) is a citywide long-term investment plan in Columbus' tree canopy. The main objectives of the UFMP are to increase Columbus' overall canopy coverage to 40% by 2050 and eliminate net canopy loss and increase tree canopy equitability both by 2030. Our team recognizes and values the time and effort put into the plan and commends the project researchers' findings. For our capstone project, we wish to amplify these findings and support the initiatives set forth by the City. The UFMP identified several challenges the city faces, and our research has identified potential solutions for these.

Research and Background Information

Urban Heat Island Effect

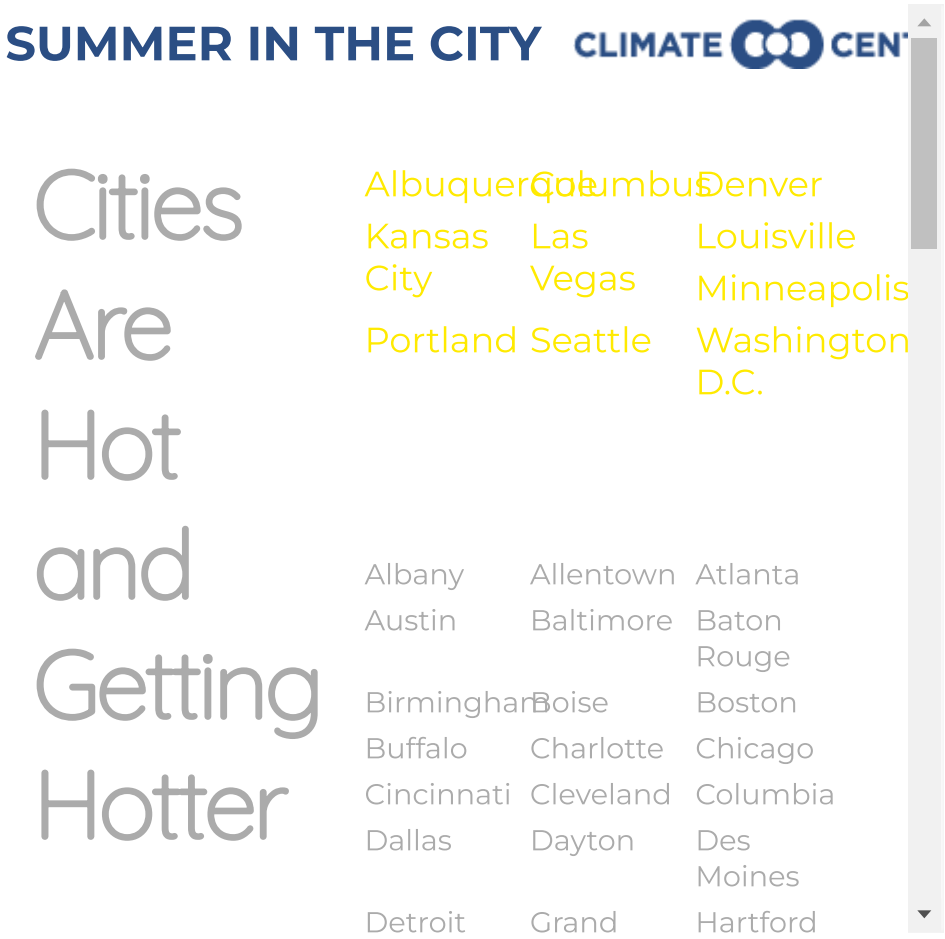
Columbus, Ohio, is a growing urban center that faces the effects of Urban Heat Island (UHI). UHI is an increase in temperatures in developed urban areas that have few trees, plants, and greenery but have a large number of roads, buildings, and other concrete and asphalt infrastructure. Infrastructure captures heat throughout the day and then releases stored heat throughout the night. Areas in Columbus affected by heat islands can raise temperatures up to 24°F in the evening hours compared to rural area temperatures.



Infographic on Urban Heat Island Effect created by Caitlin Perkins.

A study by Climate Central followed 60 large U.S. cities and found that Columbus is among the top growing Urban Heat Island and ranks 8th for the largest difference between urban and rural temperatures (using a 10 yr. average). The difference between Downtown and commercial areas averages 4.4°F degrees warmer than in rural areas, higher than the average of 2.4°F across all 60 cities in the study.

Click on and interact with "Summer in the City" by Climate Central below to explore how UHI is affecting different cities in the United States.



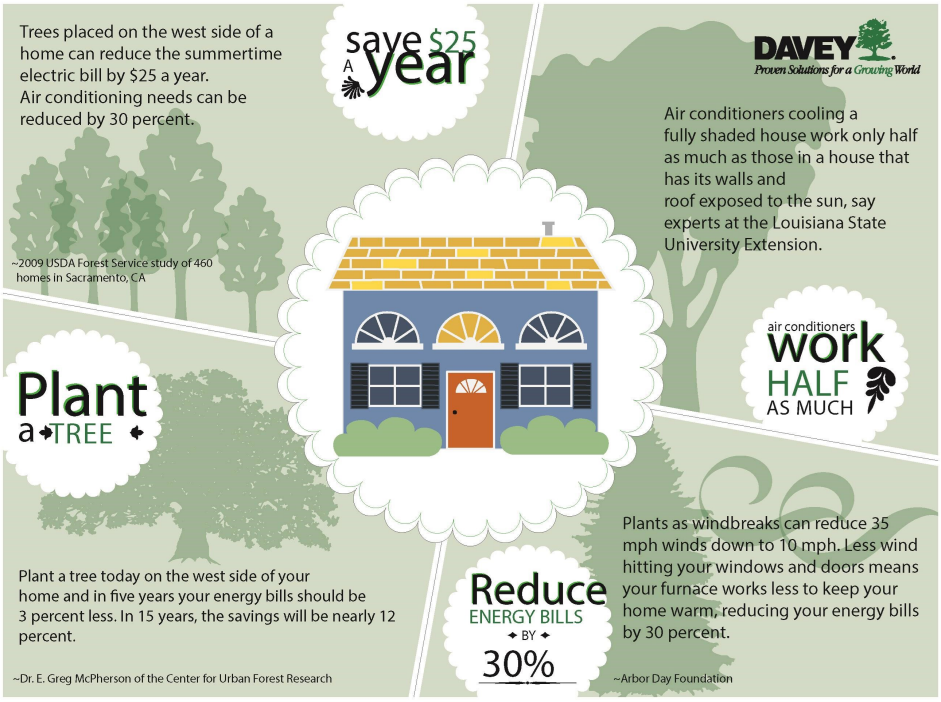
Urban Heat Island https://www.climatecentral.org/wgts/UHI/index.html?utm_source=ext550&utm_medium=embed&utm_campaign=UHI

The Urban Heat Island effect creates many consequences these cities will face unless preventative action is taken. With the increased concern of climate change, which contributes to UHI, future predictions show an increase in heat-related deaths by 57% within the next twenty to thirty years. One natural resource that has been proven to alleviate heat stress is trees. A study conducted in September 2020 found that 1,200 heat-related deaths are prevented every year due to the ecosystem services provided by urban trees (“What is the urban heat island effect?”, 2020).

Ecosystem Services of Trees

Trees provide many economic, environmental, and health benefits to a community. Some of the many benefits include:

- Offsetting the Urban Heat Island Effect
  - The presence of mature trees can reduce pavement temperatures from 5°F to 25 °F.
- Filtration and interception of rainwater and runoff.
  - Different trees will provide larger benefits. For example, a mature deciduous tree can intercept upwards of 500 gallons of rainwater annually while a mature evergreen tree can intercept up to 4,000 gallons annually.
- Production of clean air.



Reduction in energy costs and energy usage. Image by Davey: https://www.davey.com/arborist-advice/pdfs/reduce-energy-costs/

- Reduction in energy costs and energy usage.
  - With intentional planting and/or properly caring for and maintaining existing trees, trees can save up to 30% of household energy usage as explained in the infographic by Davey above.
- Reduction in crime.
- Increased property values:
  - 2% increase for lots with mature trees.
  - 3-5% increase for lots with trees in the front yard.

    - 6-9% increase for lots in neighborhoods with high canopy coverage.
    - 10-15% increase for lots in high-income neighborhoods with mature trees.
- Improved physical and mental health.
    - The table below, included in the Cleveland Tree Plan: 2020 Tree Canopy Progress Report, compares baseline numbers of physical health incidents from 2011 to updated data from 2017. The table shows all health incidents, such as bronchitis, asthma exacerbation, and school loss days, had gone down by almost half after six years of urban tree planning efforts.

Adverse Health Incidents Avoided	2011		2017	
	Incidents Avoided / Year	Value	Incidents Avoided / Year	Value
Respiratory Symptoms	532	$ 45,640	443 ▼	$ 42,544 ▼
Bronchitis (acute & chronic)	0.4	$ 35,521	0.2 ▼	$ 19,038 ▼
Acute Myocardial Infarction (heart attack)	0.1	$ 11,762	0.1	$ 6,008 ▼
Hospital Visits (Emergency / Hospital Admissions)	3.4	$ 62,257	2 ▼	$ 33,867 ▼
Asthma Exacerbation	495	$ 40,995	153 ▼	$ 12,656 ▼
Mortality	0.86	$ 6,656,299	0.5 ▼	$ 3,565,375 ▼
School Loss Days	146	$ 14,358	77 ▼	$ 7,530 ▼
Work Loss Days	26	$ 4,460	13 ▼	$ 2,171 ▼
Total	1204	$ 6,871,292	688 ▼	$ 3,689,189 ▼
Total	**1204**	**$6,871,292**	**688 ▼**	**$3,689,189 ▼**

This table was provided from the Cleveland Tree Plan: 2020 Tree Canopy Progress Report. The data being compared is from the 2011 assessment to the 2017 assessment of tree canopy and health benefits. http://www.clevelandtrees.org/wp-content/uploads/Cleveland-Tree-Plan-2020-Tree-Canopy-Progress-Report.pdf

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Case Study Examples

Case Study 1: Philadelphia, Pennsylvania

Creating Climate-Resilient Communities through Vacant Lot Restoration
https://phsonline.org/programs/transforming-vacant-land

Philadelphia Land Care (PLC), part of the Pennsylvania Horticultural Society, manages around 12,000 of the 40,000 total vacant lots throughout the city. Of the 12,000 PLC manages, 7,500 have been stabilized with 800 lots being turned into

green space and commercial or residential properties. The video to the right explains how restoring vacant lots creates more welcoming, resilient communities and introduces several leaders of these efforts. Philadelphia Land Care identifies lots with the help of concerned citizens who feel a specific lot needs maintenance. PLC then works with 18 community-based organizations, trained volunteers, and local contractors to keep these lots in good condition. Their maintenance includes a “Clean and Green” program in which a team will remove all trash and weeds, lay down grass seed, remove broken branches or tree limbs, and grade the lots on a scale of poor to good.

The images below are before and after shots of several vacant lots in Philadelphia, PA, that have been "Cleaned and Greened," as described above. Stabilizing the land is a process that includes removing trash and debris from the parcel and trimming existing weeds and grass. Next, grass seeds may be laid down, trees planted, and wooden fencing built around the perimeter to show the lots are cared for.

The images above feature several properties in Philadelphia, PA, before and after stabilization.

Though the lack of trees and the presence of unkempt vacant lots may seem like an environmental issue, it is also a social justice issue. Disinvestment and urban blight in certain neighborhoods have caused an increase in feelings of depression in residents. With initiatives that increase tree canopy and green space, residents in the surrounding area have seen decreased feelings of depression by 40%. Another issue that residents in disinvested areas struggle with is petty and violent crime. Below is a podcast, "Cleaning & Greening" by (Re)Search for Solutions, discussing gun violence with Keith Green, Director of the Philadelphia LandCare Program at PHS, as an added resource. A study done on Philadelphia Land Care's Clean and Green initiative has shown that violent crime such as gun violence has decreased by 29% around lots maintained by the group, and the podcast further discusses this topic.

Click on the page below to scroll through Episode 1: Cleaning & Greening or access the website through the link

in the description below.

Case Study 2: Cleveland, Ohio

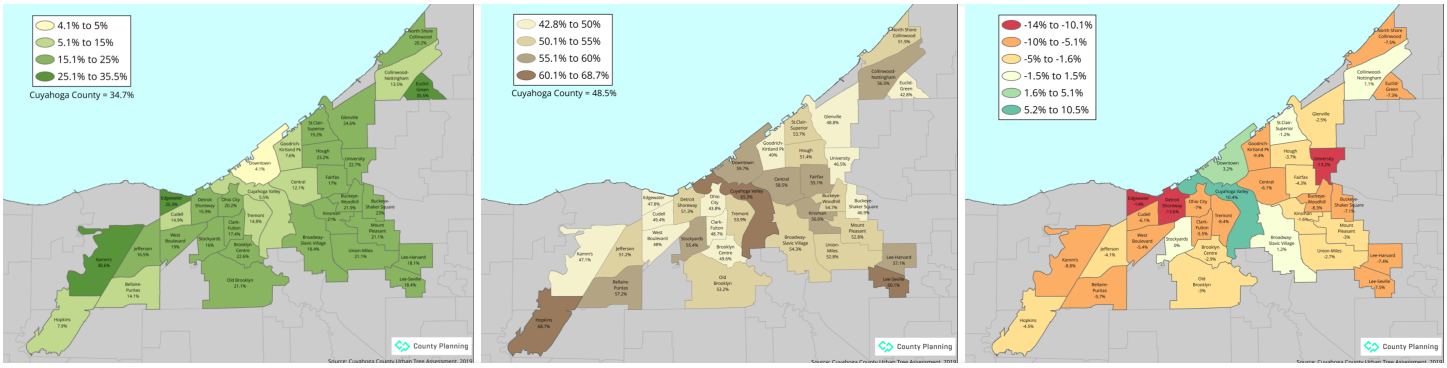
Another case study our team looked at was an example in Cleveland, Ohio. The Cleveland Tree Plan was developed in 2015 by five organizations known collectively as the Cleveland Tree Coalition (CTC). Within five years, over 40 organizations now partner with the coalition to protect and contribute to urban tree canopy growth in Cleveland. The original Cleveland Tree Plan was released in 2015, and in 2020, the CTC released The Cleveland Tree Plan: 2020 Tree Canopy Progress Report. The 2020 report discussed the progress that had been made within those five years, what data had been collected and changed, and steps moving forward. The assessment identified several areas of progress and two main issues.

One issue was the original goal of a 30% canopy increase by 2040. They found this goal to be unrealistic, as 28,500 trees would need to be planted per year, costing an estimated $8.6 million annually. The other identified issue was the voluntary reporting of tree planting information. Details such as where and what type of tree had been planted, and the number of trees, weren't always collected. Moving forward, Cleveland set three broad goals:

1. Recognize trees as critical community infrastructure.
2. Reverse the trend of tree canopy loss.
3. Assume full stewardship of the tree infrastructure.

Within those three overarching goals, nine actions were assigned, including establishing a unified voice, planting with a purpose, instituting policy changes, and completing a tree inventory (Cleveland Tree Plan: 2020 Tree Canopy Progress Report, 2020). Many of these broad goals and action steps identified were also mentioned in the Columbus Urban Forestry Master Plan as areas of improvement.

Below are several maps of the Cleveland area created by Sustainable Cleveland. These maps identify the Existing Tree Canopy in 2011, shown in green; Possible Tree Canopy, shown in beige and neutrals; and lastly, the Change experienced from 2011 to 2017, shown in mostly oranges and reds. Though Cleveland began the effort of expanding its tree canopy in 2011, most neighborhoods experienced tree canopy loss within the six years between 2011 and 2017. Moving forward, Cleveland identified the possible tree canopy growth and created The Cleveland Tree Plan: 2020 Tree Canopy Progress Report to support their goal of growing the urban tree canopy. Columbus could utilize the City of Cleveland's experience and efforts to identify the most efficient actions, learn what to do and what not to do, and be honest about setting realistic goals.



From left to right: Existing Tree Canopy 2011, Possible Tree Canopy, Change from 2011-2017.
https://www.sustainablecleveland.org/dashboard#natural_dashboard

One of the five original organizations that make up the Cleveland Tree Coalition is The Cleveland Western Reserve Land Conservancy (CWRLC). The CWRLC hosts a program called Reforest Our City that began in 2015. Since the project's inception, CWRLC has planted and distributed around 14,000 trees and has trained hundreds of volunteers through their Tree Stewardship Program. This program trains volunteers to engage the community in tree maintenance and planting and includes complimentary classes such as basic arboriculture skills. The video to the right explains who the Cleveland Western Reserve Land Conservancy is, information on their Reforest Our City Program, Tree Stewardship Program, and gives testimonies by employees and residents on what these initiatives have done for the community (below is a video guide with marked minutes and descriptions of what it discusses).

The Return of the Forest City.
https://www.wrlandconservancy.org/whatwedo/reforest-our-city/

- The Return of the Forest City Video Guide
  - 0:00 to 2:15 - Introduction of CWRLC and the Reforest Our City Program
  - 2:16 to 4:45 - Tree Stewardship Program
  - 4:46 to 7:59 - Vacant Lot Project Description
  - 8:00 to 11:57 - Leader and Resident Testimonies

Budgeting and Costs of Tree Maintenance

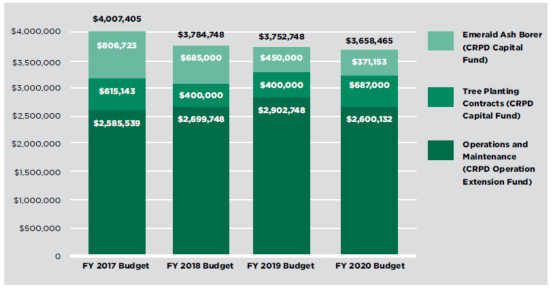


Figure 14. Columbus Forestry Budget 2017-2020

The City of Columbus Department of Development owns around 1,600 vacant lots and spends $500,000 on maintenance of vacant lots, with $400,000 dedicated toward cleaning illegal dumping, and another $50,000-$75,000 on tree

Another figure in the Urban Forestry Master Plan technical report showed that funding for the city has decreased since 2017. This has resulted in a 6-12 month backlog of removal and tree pruning orders. https://www.columbusufmp.org/uploads/2/6/0/6/26062495/final_columbus_ufmp_technical_report_-_april2021.pdf

maintenance. An additional $500,000 is spent on mowing grass on vacant lots. Being proactive on issues such as illegal dumping, littering, and tree care, the city could save hundreds to thousands of dollars on vacant lot maintenance. Showing the neighborhood and community that these lots are being cared for and looked after could deter people from these illegal activities. Investing in initiatives such as community gardens and side lot programs could save the city from mowing lots, as well.

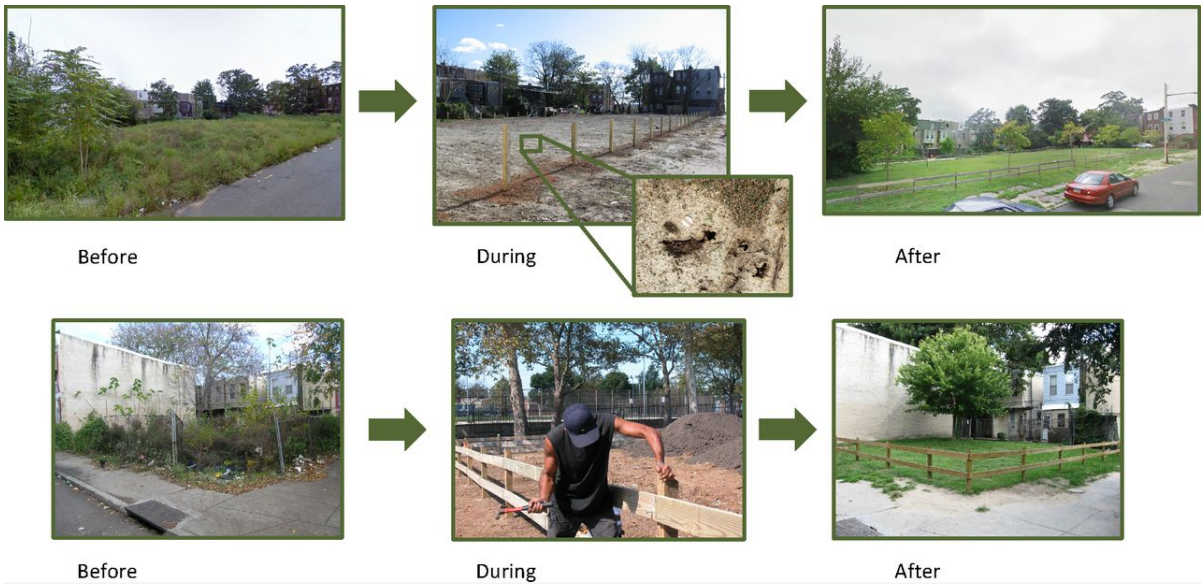
Results from the Columbus Urban Forestry Master Plan (UFMP) showed that Columbus's per-tree spending was 38% lower than the average of all surveyed cities and 20% lower than Midwest cities surveyed in the Municipal Tree Census. The UFMP emphasizes how tree maintenance is underfunded, stating that 36% of communities felt their current budget was inadequate and supplied 45% below their actual need. To the right, Figure 15 shows that Columbus only spends $26.51 per street tree whereas other midwest cities spend $35.68 and all other U.S cities spend $42.59 per street tree.

Figure 15. Annual Budget Spent per Street Trees by US Communities (Source: 2014 Municipal Tree Census)

https://www.columbusufmp.org/uploads/2/6/0/6/26062495/final_columbus_ufmp_technical_report_-_april2021.pdf

One city we compared Columbus's budget and spending to was Philadelphia, Pennsylvania. The Pennsylvania Horticultural Society (PHS) estimates that it costs roughly $1.50 per square foot to stabilize a vacant property, and maintenance costs are estimated at $0.15/sq. ft. each year. Philadelphia Land Care, mentioned previously in Case Study Examples, has installed wooden railings around the perimeter of vacant lots, creating an important visual sign that the property is cared for, deterring dumping and other illegal activity on the property. The City of Columbus has installed wooden railings on vacant properties in the past; however, a

majority of these railings have been vandalized. Continuous maintenance for wooden railings, trees, and the vacant lots would drastically cut the city's costs in regard to removing illegal dumping.



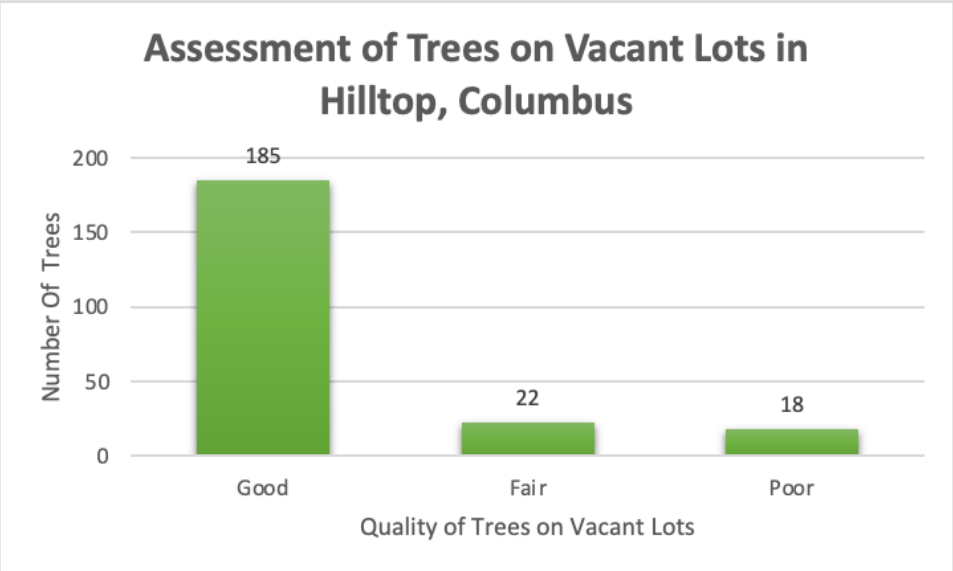
Wooden Railing Installation in Philadelphia, Pennsylvania.

Another way investing in trees and caring for vacant lots pays off is through decreased rates of crime. In 2018 the Proceedings of the National Academy of Sciences (PNAS) conducted a study on vacant lot restoration and its effects on violence, crime, and fear. PNAS randomly selected 4,400 remediated vacant lots in Philadelphia, and researchers discovered that after the first year each lot earned a $26 return on investment to taxpayers and a $333 societal return on investment for firearm assaults. In just under 4 years the remediated lots earned a $77 return on investment for taxpayers and a $968 societal return on investment from decreased firearm assaults. This example shows that investment and increasing urban tree canopy in the community pays off in many different ways.

Vacant Lot Survey Results

Columbus Vacant Lot Assessment

As an initial baseline assessment to inform Columbus of the presence and condition of trees on city-owned vacant lots, we analyzed 125 individual lots within the Hilltop neighborhood utilizing *Google Maps: Street View*. Ten lots were inconclusive due to image quality, so results were only recorded for 115 lots. Variables considered in the assessment included the number of trees per lot, a basic tree quality rating of either good, fair, or poor, the presence of invasive species on or near the trees, and whether or not the trees provided shade.



Quality of Lot Trees Graph created by Xavier Green.

As shown in the graph above, there were a total of 225 trees counted with an average of two trees per lot. 82% of them were in good condition and 8% were in poor condition. This suggests that once trees are established, the maintenance required should be minimal.

Below is an example of a good quality tree vs a poor quality tree within the assessment. The good quality tree on the left has limbs intact, no obvious invasive species present, and healthy foliage (lack of foliage did not preclude a good scoring due to dependence on when an image was taken). Despite all of the green, the pine

tree in the right photo is of poor quality due to the fact that it is completely overtaken by an invasive species.

Left Photo: Example of tree in Good condition / Right Photo: Example of tree in Poor Condition.

Not only does this lot assessment provide insight into the presence and health of trees on vacant lots, but it also serves as an example starting point for a city tree inventory. These baseline assessments could be done quickly and cheaply, and inform which lots need more attention.

Policy Examples From Alternate Cities

The Columbus Urban Forestry Master Plan identified several areas of tree protection policy deficiency when compared to several other cities within and outside of Ohio. These deficiencies fell broadly under land use regulation, private tree damage and removal, regulated features on private property, general tree protection measures, site planning, development measures, and mitigation measures. To assist in

Tree Protection and Preservation

	Columbus, OH	Gahanna, OH	Dublin, OH	Charlotte, NC
Land Use Regulated				
Single/two-family Residential		●	●	●
Multi-family Residential	x	●	●	●
Commercial/industrial		●	●	●
Public Land	●	●	●	●
Public Tree Damage and Removal				
Restricts tree removal on public property	●	●	●	●
City permit or approval required for tree removal, pruning or excavating	●	●	●	●
Prohibits damage to public trees (e.g. ropes, signs, wires, and excavation)	●	●	●	●
Private Tree Damage and Removal				
Restricts tree removal on private property		●	●	●
City permit or approval required for tree removal on private property		●	●	●
Requires preservation of trees during development on private property		●	●	●
Prohibits damage to preserved/protected trees		●	●	●
Regulated Features on Private Property				
Forests/wetlands		●	●	●
Specific species and/or size tree (e.g., heritage/significant trees)	x	●	●	●
Tree critical root zone/dripline			●	●
Amount of canopy cover (minumum amount set)				●
Riparian buffers, natural areas, preservation zones		●		●
Tree Protection Measures				
Tree protection/preservation preservation plan required		●	●	●
Identification of prohibited activities in dripline/critical root zone		●	●	●
Tree protection fencing or other protection measures required		●	●	●
Credits/incentives for tree preservation		●		●
Site Plan/Development Requirements				
Inventory and location of trees/forests/woodlands on site		●	●	●
Tree protection/preservation plan		●	●	●
Tree protection measures (e.g., fencing, soil protection, trunk protection)		●	●	●
Landscape plan with mitigation plantings		●	●	●
Grading and utility plans with trees		●	●	●
Mitigation/Penalties				
Tree planting requirements for removal of regulated trees	●	●	●	●
Fee in lieu of planting mitigation trees	●		●	●
Tree planting establishment, maintenance and survival requirements		●	●	
Penalties established for damage and removal of preserved/saved trees		●	●	●
Tree fund	●	●		●

Note: 'x' Only applies to University District zoning overlay.

Policy Comparison from Columbus UFMP

correcting those deficiencies, policies regarding tree protection and upkeep were researched from major cities around the nation, particularly from cities that also had a land bank program. The hope is that these policies could serve as a potential framework for future Columbus legislation.

Click here or explore the interactive map below to view examples of novel policies from various US cities regarding tree maintenance, management, preservation, and additions meant to inform the City of Columbus in future urban canopy initiatives.

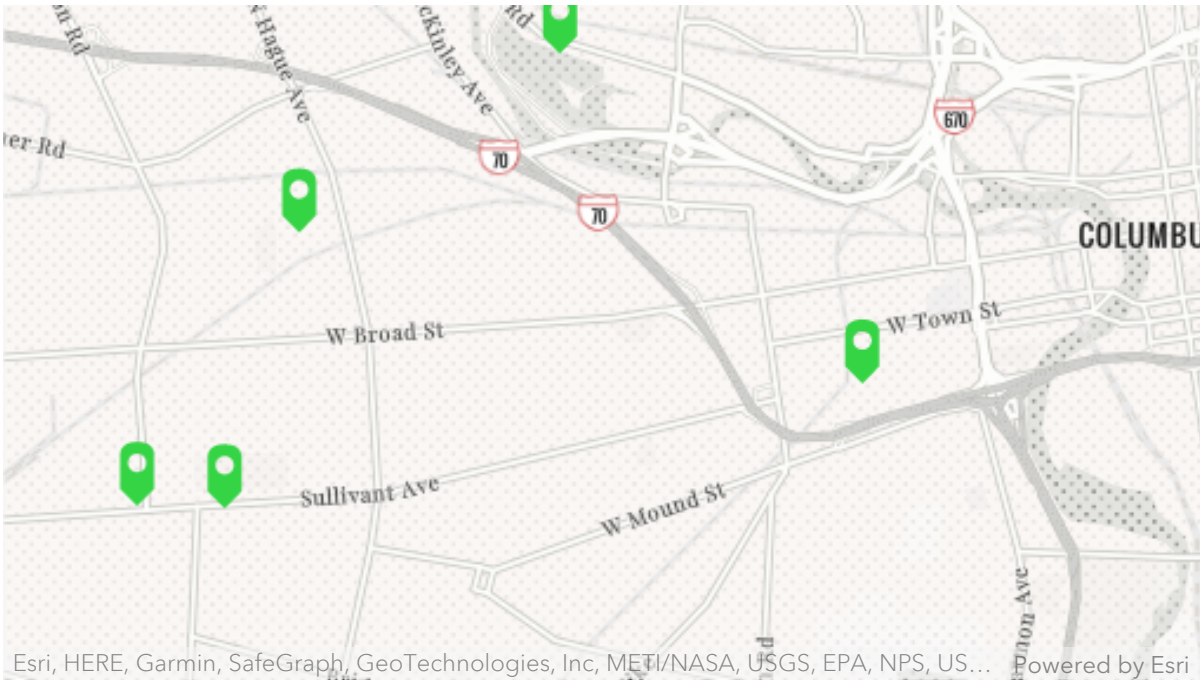
Hover over the various map markers to see policy examples across the United States.

Possible Organizations to Involve in Hilltop, Central Ohio

As discussed above, including the community and community-based organizations in the effort to grow Columbus' urban tree canopy is vital to making the goal become reality. Below are several organizations based in and around the Hilltop neighborhood where our team assessed 125 vacant properties. Community involvement ranges from young children and adults from all backgrounds, and these organizations capture those groups.

Below is an interactive map of different organizations around the Hilltop area that Columbus could consider working with for future urban canopy initiatives.

Hover over the various map markers for more information on each organization.



Map of Possible Organizations to Involve in Hilltop, Central Ohio

1. **MY Project USA**
    a. Mission Statement: “My project USA is a national initiative to protect and empower our youth and families. We are

headquartered in the Hilltop area of Columbus, OH. We uplift underprivileged, crime-ridden neighborhoods. We strengthen abused, neglected, and underserved communities and get the very best out of them through social services and civic engagement. We are the largest Muslim Social Services Organization in Ohio."

   b. Increasing tree canopy has been proven (through the study in Philadelphia, PA) to decrease rates of crime and empower communities. Involving individuals from this organization could empower them and engage them in creating a more vibrant community to live in.
   c. https://www.myprojectusa.org

2. **Friends of Hilltop**
   a. Mission Statement: "Create a sense of well-being through environmental improvement, maintenance, and management, thus creating ownership and empowerment in the greater Hilltop area."
   b. This organization would be great to partner with because of its focus on maintenance and management. Including them in ongoing tree maintenance could be particularly beneficial for organization and communication.
   c. https://columbusfoundation.org/the-giving-store/nonprofit-directory-listing/FriendsOfTheHilltop/3007
3. **Ohio Youth Development**
   a. Mission Statement: "Ohio Youth Development (OYDKIDS) is a nonprofit community-based program in Columbus, Ohio. Our activities are free and low-cost. Children in K-12 participate in health & fitness, academic tutoring, and creative activities."
   b. Engaging with youth is rewarding to the community and to the future. Educating them on the importance of trees and allowing them to get their hands dirty with intentional planting programs could spark passion, purpose, and creativity.
   c. https://m.facebook.com/oydkids.org/about/?ref=page_internal&mt_nav=0&refsrc=deprecated&_rdr
4. **NAMI Ohio**

a. Mission Statement: “NAMI Ohio improves the quality of life and ensures dignity and respect for persons with serious mental illness, and offers support to their families and close friends.”
b. Feelings of mental illness like depression decrease as greenery increases. Holding intentional planting programs with persons who suffer from mental illness could give them a sense of accomplishment and purpose, as they would be contributing to a long-term urban tree canopy growth plan.
c. https://namiohio.org

5. **Lower Light Ministries**
   a. Mission Statement: “Lower Lights Ministries is a nonprofit organization in Columbus, Ohio- breaking cycles of poverty and addiction for youth, adults, and ex-offenders.”
   b. Philadelphia, Pennslyvania, involves many ex-offenders in their yard maintenance in an effort to reduce recidivism. Involving this organization could give participants a hand in changing their community for the better and could be organized in such a manner where there are leadership development opportunities. This could be an entry into the Tree Stewardship Program discussed in the Conclusions and Recommendations below.
   c. https://www.lowerlights.org
6. **YMCA of Central Ohio- Hilltop**
   a. Mission Statement: “Our Changing Communities: Communities across the U.S. are rapidly changing. As neighborhoods become more diverse, it is important that we, with great intentionality, understand who is in our communities and how best to serve their interests and needs.”
   b. The YMCA is a well-known organization with many connections within the community. Involving them could give more structure to the canopy growth goal by providing volunteers and helping hands.
   c. https://ymcacolumbus.org/locations/hilltop

Involving community groups such as these throughout Columbus can give the residents who are affected by low urban tree canopy a voice and a way to change their reality.

Limitations to Our Research

Throughout our project, we experienced various challenges and limitations to our research. Some of these limitations include:

- **Time Restraint and Scheduling Conflicts:**
  - Our group started working on this project toward the end of January, giving us roughly eight weeks to complete our research, lot assessments, interviews, and our report (this webpage).
  - With all of us being students, we had to learn how to balance work in our other classes, figure out when to meet with each other for this project, and when we would dedicate time to this project. One method we used to help with our research was interviewing people who are knowledgeable on trees and maintenance, but finding a time where multiple group members could join the call could be difficult.
- **Finding Relevant and Accurate Data:**
  - Our team found data and research on vacant lots and tree maintenance from all over the country; however, finding data on Columbus specifically was a challenge. This is a limitation, but also a realization that with the recent release of the Urban Forestry Master Plan and our research, finding information on this topic can become easier.
  - Another part of our project was to assess trees on vacant lots. Since our project took place throughout the spring semester, our group couldn't go out and physically assess the trees because there wasn't (and still isn't in mid-April) foliage and leaves. Utilizing Google Earth and Google Maps to assess the trees made for a quicker and more efficient

way to access tree data; however, for some images it was hard to tell if there were invasive species present or the true condition of the lot. All of the lots we assessed were in the Hilltop neighborhood, which could also be seen as a limitation since there are many other neighborhoods with higher and lower tree canopy, so data may not be accurate for the entirety of Columbus.

Although we faced limitations and challenges, our group was successfully able to make conclusions and recommendations following our assessments, research, and interviews.

Conclusions and Recommendations

Through our research, our team found these six recommendations to be the most fitting for Columbus. With the collaboration and efforts of community-based organizations, residents, and the City of Columbus, the Urban Forestry Master Plan's three goals of increasing Columbus's overall canopy coverage to 40% by 2050, eliminating net canopy loss by 2030, and increasing tree canopy equitability by 2030 could become reality.

1. **Education:** Though many people may agree a tree is nice to look at, others think of maintenance and potential hazards. However, educating the community on the ecosystem services a tree provides to a household and the neighborhood is vital to supporting Columbus's goal of tree canopy growth.
2. **Tree Stewardship Program:** A program that trains volunteers to care for vacant lots and trees on vacant lots/private land alike will allow for a more productive and engaged community. Having individuals in a community who are knowledgeable and passionate plants the seed of success for grassroots movements such as this.
3. **Ongoing Maintenance Program:** Members involved with the Tree Stewardship Program, volunteers, community-based

organizations, and local contractors can become involved in a proactive tree maintenance program. By having a set schedule, these lots can be cared for on an ongoing basis.

4. **Community Involvement:** Involving the community in the decision-making process and caring for the trees would be beneficial for the Columbus Urban Forestry Master Plan's success. Having community days and programs that educate both children and adults can stimulate growth, connections, and passion. This recommendation can be carried out by the City of Columbus, the Parks and Recreation Department, and/or any of the organizations listed above if they wish to be involved.
5. **Increased Communication Among Involved Groups:** It has been made clear that lack of communication across several groups has caused tree loss and prevented the canopy from growing. Improving communication about the importance of trees includes keeping developers, private landowners, community members, representatives, community groups, and others educated and updated.
6. **Policy Implementation:** Though all of these steps are important to the success of canopy growth, policy implementation sets it all into place. There are various policies and programs utilized by similar cities that could serve as a framework to guide future policies in Columbus. If protecting these trees is a priority to the city, policies should be implemented and followed.

The goals the City of Columbus set in the Urban Forestry Master Plan are going to take a lot of effort across many different groups. With these six recommendations, Columbus could be on its way to achieving those goals.

Columbus, OH. Image from https://en.wikipedia.org/wiki/Columbus,_Ohio

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Thank you!