Determining Possible Planting Space in the Austin Area

Treecon Solutions

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1. Introduction

1.1 Summary

The Urban Tree Canopy or UTC is defined as the entire vegetation layer that overshadows the surface when viewed from above. (Raciti pg.58) It serves as a useful metric when attempting to quantify a city's Urban Forest. This is important as it gives city officials a way to determine where and how well the benefits of the urban forest are serving its residents. As the world moves toward climate conscious culture, several cities in the United States have put forth initiatives to preserve or promote their Urban Tree Canopies. Among these the City of Austin has outlined a Climate Equity Plan, an initiative that involves attaining net-zero greenhouse gas emissions by 2040 while also extending the benefits of the UTC to the historically underserved populations of Austin. Treecon has been tasked with identifying the possible planting space in Austin with classified tree canopy layers derived from aerial imagery so that the city's goal of 50% canopy cover by 2050 can be realized. Utilization of clips, merges and attribute selection, the possible planting space of Austin will be identified and ranked to assist the Urban Forestry Program's efforts to provide climate equity to Austin's burgeoning population.

1.2 Purpose

This study will analyze the current tree canopy over the Austin Municipality and ultimately determine potential planting space in the study area. The project will define the areas inside Austin that provide maximum tree canopy coverage currently to then compare with the possible planting space available. Secondly, constraints will be applied to the analysis to improve tree canopy equitability of Austin's underserved population areas by refining smaller areas of interest inside the defined Eastern crescent as well as zip code areas provided by GAVA. Finally, a possible planting space map will be presented to the client that demonstrates the immediate actionable PPS of public land owned by the City of Austin for both the entire study area boundary and the selected areas of interests proposed.

1.3 Scope

The study area is bounded by the entirety of Austin's watershed that is displayed in Fig. 1 with a focus on the Eastern Crescent denoted here in Fig 2. The study area data is from 2018 sourced from aerial imagery of the watershed. All processes attributable to this project will be initiated and completed during the Spring 2023 semester between February and May of said year.

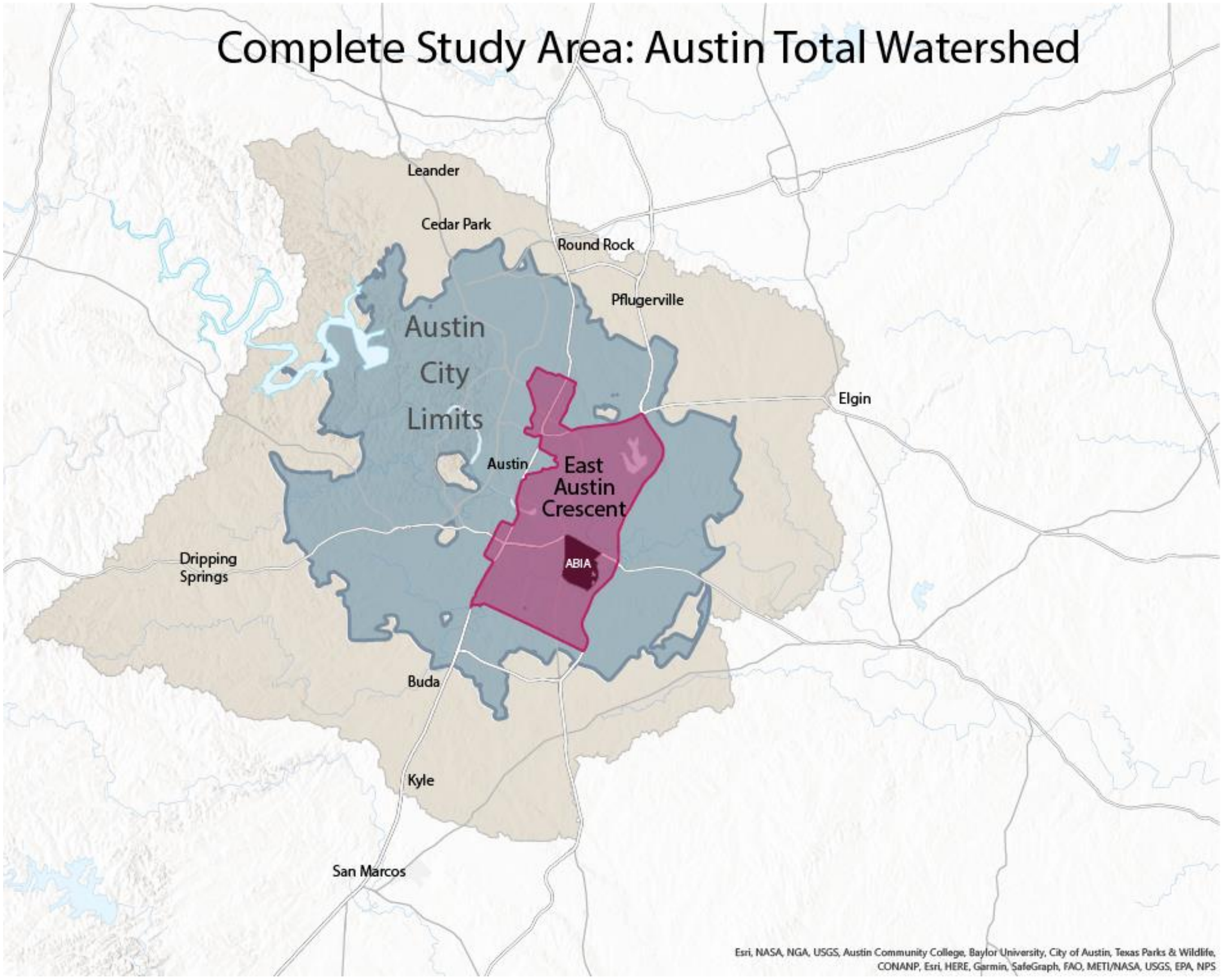


Figure 1. Austin Watershed and Municipality Boundaries.

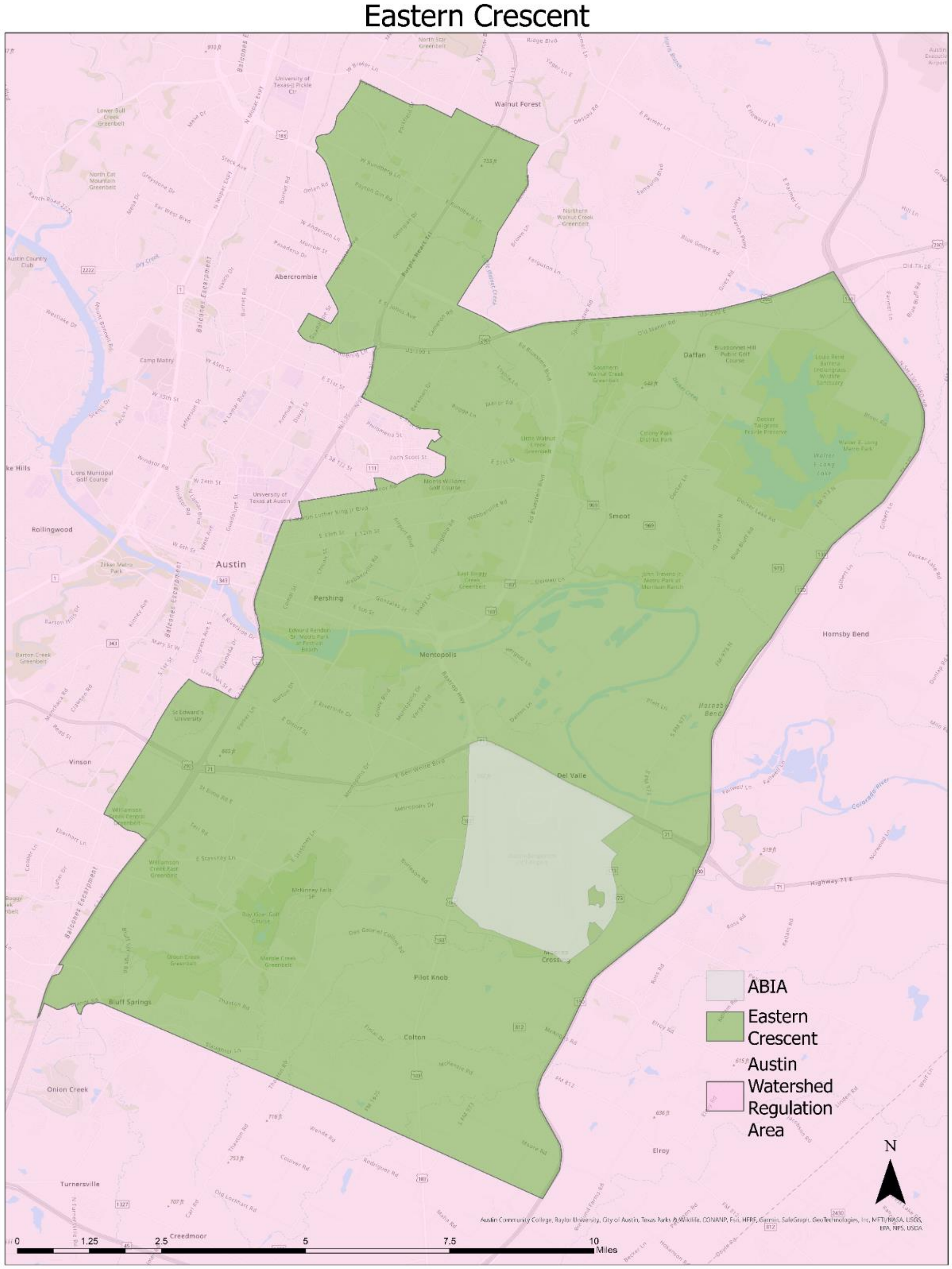


Figure 2. Eastern Crescent Boundaries

2. Literature Review

For our study we were fortunate to be provided with two important sources to begin our understanding of Possible Planting Space. The first resource was published by the US Department of Agriculture Forest Department and entailed information on the assessment of UTC or Urban Tree Canopy (USDA 2019). Essentially the publication details how UTC is useful for cities to measure the status of the tree canopy and how it is distributed over the urban space that they oversee. This information gives city officials important details on what properties, areas, and zone types are receiving or not receiving urban forest benefits. Initiatives can then be developed to tackle whichever goals the city wants to achieve with their urban forest such as urban heat dissipation, gross canopy cover, climate equity, air quality and watershed management among others not mentioned (USDA pg.2). The second resource was a manual for *Urban Tree Canopy Goal Setting***,** which provided important definitions for what urban tree canopy (UTC) is as well as a contextualized manual for Urban Tree Assessment to the Chesapeake Bay Watershed allowing the team to better understand the subject with a real-world study area to compare to Austin (Raciti pg.58).

With the overview of Urban Forestry understood, we parsed a few sources on the importance of tree canopy benefits in the urban setting. One recurring theme was urban heat reduction by improving tree canopy. Studies conducted in the cities of Baltimore, Beijing, Sacramento and Shenzhen all involved on efforts to reduce urban heat via urban forestry planting of trees (Wang pg. 147) (Werbin pg. 1). Interestingly, the Boston study suggested that it is more efficacious to pursue public directives into removing “hot” urban infrastructure like replacing pavement when possible (Werbin pg. 5). The study focusing on the other cities found a common trend on land surface temperatures noting diminishing returns past a certain cooling threshold with increase of percent canopy coverage and differing results between cities likely due to regional climate differences (Wang pg. 149). The team took this as understanding that tree planting initiatives are not the end all be all of urban heat reduction in spite of being demonstrated to have a desired effect. Additionally, one source focused on noise reduction benefits of wooded areas. In this study of Birmingham, UK the researchers identified that wooded areas help to dissipate noise from sources like roadways effectively and during urban planning it is useful to prioritize placing wooded areas between residential zones and noise producing infrastructure (Fletcher pg.13). One final interesting study recognized was one conducted to try and establish a correlation between mental health decline and greenspace inaccessibility in Philadelphia (Kondo pg.4). Although the primary aspects of the study were not necessarily within the scope of our own project, this study provided important quantification of what to consider as areas lacking in canopy access/cover as the residents living in poor socioeconomic zones lacked proximity to available green space analogous to Austin's Eastern Crescent.

Many cities have attempted to establish tree planting programs or monitor their UTC, but an interesting sustainability issue pervades many of the programs. In both Baltimore and New York there is evidence suggesting that economic disparity is present regarding urban tree canopy. In New York the study identified canopy availability and species diversity to be lacking based on socioeconomic, educational and racial stratification (Lin pg. 9). In Baltimore the same story is told and areas that were "redlined" based on real estate loan risk from 90 years ago suffer the same issue as New York (Burghardt pg.7). In both cities the trees that are present in the lower income areas are typically of a few or a single species that are young in comparison to the historically affluent areas with older more diverse tree species. A significant issue underlying this phenomenon is that the trees that are present or selected for these areas to improve UTC are a cheap species that so happens to have high mortality for the region. One such source from Italy echoed this idea as it sought to determine solutions by using diverse species in urban forestry (Speak pg.364). Our group will likely contend with this issue as a limitation as the climate of Austin isn't conducive to varied tree species without proximity to solid year-round water sources. Although we may not be able to provide a more mature solution to tree diversity, we thought it pertinent considering our efforts on this project do involve climate equity for Austin's population as the master plan Austin put forth states it will follow the most modern guidelines to establish diversified tree species planting. However, regarding climate equity based on race and socioeconomics the team expects to find similar results in canopy distribution as found in the aforementioned studies.

Our team has been provided with aerial imagery to conduct the analysis of our project. But other cities have utilized similar albeit different data sources to complete the same task. A study conducted in Mexico City was able to determine “Potential Tree-Planting Sites” via object-based classification from imagery sourced from the SPOT 6 satellite (Bravo-Bello pg. 3). The first publication from the USDA forest service mentions that LiDAR is now being used to aid in UTC assessments and the earlier New York City study corroborated this by using a 6-inch resolution LiDAR data set to then use object-based classification to determine tree canopy (Burghardt pg.3). The team thought it would be useful to see if different sourced datasets outside of the provided NAIP imagery could be useful in comparing the same analysis to test for accuracy and precision. From the sources we have read it is likely that object-based image classification will be the best methodology should we end up attempting the analysis with LiDAR or satellite imagery, but the team understands that this is more of a goal that should only take precedence once the client deliverables are completed.

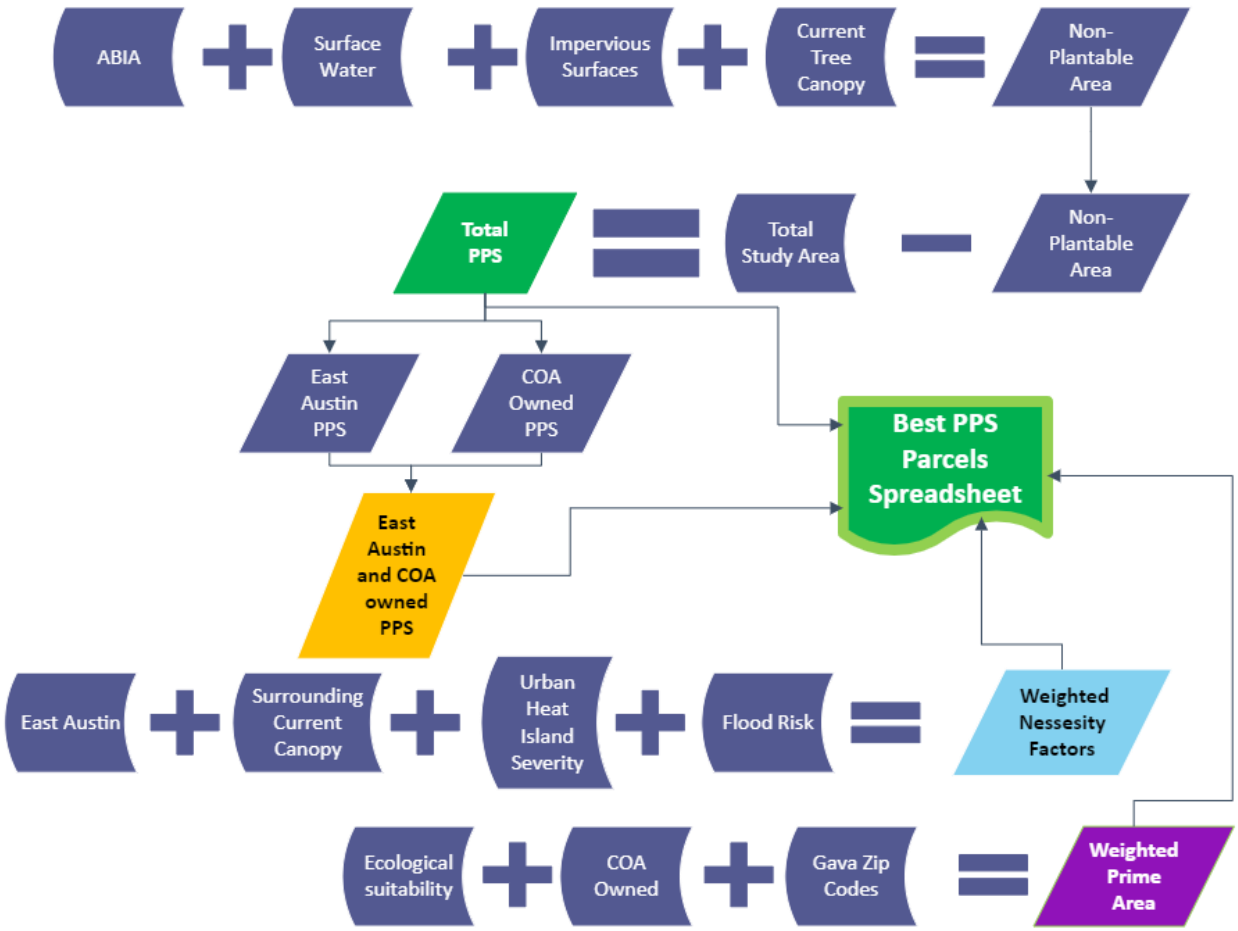
3. Data

Entity/Name	Source	Provided, Found, Deliverable	Data Type	Status
Austin City Limits	COA	Provided	Vector	Current
Austin Watershed Area	COA	Provided	Vector	Current
Austin Watersheds	COA	Provided	Vector	Current
Surface Water	COA	Provided	Vector	Current
Impervious Cover 2021	COA	Provided	Vector	Current
ABIA	COA	Provided	Vector	Current
City of Austin owned parcels	COA	Provided	Vector	Current
Eastern Crescent Outline	COA	Provided	Vector	Current
Tree Canopy 2018 vector	COA	Provided	Vector	Current
Tree Canopy 2018 raster	COA	Provided	Raster	Current
Census	US Census	Found	Vector	Current
Urban Heat Island	USGS	Found	Raster	Current
NAIP Imagery	USGS	Found	Raster	Current
Possible Planting Space Total	Treecon	Deliverable	Vector	In Progress
Possible Planting Space East Austin	Treecon	Deliverable	Vector	In Progress
PPS City of Austin Owned	Treecon	Deliverable	Vector	In Progress

PPS City of Austin Owned and East Austin	Treecon	Deliverable	Vector	In Progress
PPS Spreadsheet weighted ordered	Treecon	Deliverable	Vector	In Progress

4. Methodology

To determine the PPS, we will use ArcGIS Pro. First, we will make a non-plantable surface layer. We will then subtract the non-plantable surface layer from the total study area to get the Total Possible Planting Space layer. We will then make two new layers from the PPS layer. We will make a PPS layer for the East Austin crescent, and one for PPS within parcels owned by the City of Austin. We will then combine these layers to make a new layer with the areas that are in East Austin, COA owned, and have PPS. We will make a final spreadsheet weighted on factors such as surrounding canopy, if the area is in East Austin, owned by the COA, flood mitigation effect, and urban heat island effect



5. Budget

The budget totals out the cost for the full semester of work. The hourly value we calculated for each position was sourced from Salary.com. Then, we filtered out the other forty-nine states to get an average value for Texas jobs. Since we are not paid a salary for this job, we broke down the salary rate into an hourly rate for the positions. We took those values and calculated them accurately based off the hours per week and weeks worked to reach a total for Treecon. The totals for the analysts were then multiplied by three for each of the analysts.

The software package prices were then calculated for the time needed for the software, some of the programs allowed monthly subscriptions while ArcGIS did not.

Data Collection	
Manager: (5 hours/week * 2 weeks * $61)	10 hours
GIS Analysts: (10 hours/week * 2 weeks * $29 * 3)	60 hours
Total Hours:	70 hours
Subtotal:	$2,350
Pre- Processing Data and Manipulation	
Manager: (5 hours/week * 5 weeks * $61)	25 hours
GIS Analysts: (10 hours/week * 5 weeks * $29 * 3)	150 hours
Total Hours:	175 hours
Subtotal:	$5,875
Data Analysis and Interpretation	
Manager: (5 hours/week * 5 weeks * $61)	25 hours
GIS Analysts: (10 hours/week * 5 weeks * $29 * 3)	150 hours
Total Hours:	175 hours
Subtotal:	$5,875

System Management	
Manager: (2 hours/week * 4 weeks * $61)	8 hours
GIS Analysts: (4 hours/week * 4 weeks * $29 * 3)	48 hours
Total Hours:	56 hours
Subtotal:	$1,880
Website Development	
Webmaster: (6 hours * 2 weeks * $40)	12 hours
Total Hours:	12 hours
Subtotal:	$480
Software Licensing	
ArcGIS Pro All Extensions Bundle: One Year License = $1,950	
Microsoft 365 Basic Business: 6 Month License = $36	
Adobe Illustrator: 6 Month License = $126	
Subtotal:	$2,112

Total for Labor: $16,460
Total for Software: $2,112
Total Cost = $18,572

6. Timetable

The timetable was outlined by the team's goals and objectives. The first month leading up to the proposal has been data collection, research and examining the fine details of the COA PPS project. After the proposal the team will be able to receive feedback from the client and understand if the client thinks our approach is right or wrong. Treecon will then be able to start the data analyzation and acquisition of the potential planting space in Austin.

Treecon will then access the problem and meet with the clients again on March 29th, 2023. They will receive final thoughts from the clients and update them on any final challenges or limitations the team runs into. Finally, completing the project in the 2nd week of April and then preparing for the final presentation.

Phase	Item	Date
Introduction and Outline	Collect data	Jan 29 to Feb 19
	Research	Jan 29 to Feb 19
Proposal	Proposal Presentation	Feb 22
	Proposal Paper	Feb 22
Analysis	*Geoprocessing*	*Feb 22 to Mar 20*
	Design Progress Report	Mar 22
	Finalize progress reports	Mar 27
Assessment	Progress Report Presentation	Mar 29
Final	Finalize all deliverables	Apr 25
	Final Paper	Apr 25
	Final Presentation	May 1

7. Final Deliverables

A final report accompanied by a poster with results will be included, as well as a website, presentation slides, and a spreadsheet listing properties available for planting. Final maps will include total possible planting space in the total Austin area watershed, possible planting space in the Eastern Crescent, and the prime Austin owned possible planting space. A spreadsheet including the areas we believe to be the most vital parcels of PPS, weighted by factors discussed in Methodology, will be included as both a .csv, and a shapefile.

8. Conclusion

This project will identify possible planting space that is available to become canopy in the Austin watershed area. There will be a focus on the Eastern Crescent and GAVA communities which include zip codes 78744, 78745, 78752, 78753, 78759. This area has been underserved so we should find many areas available for improvement. Some concerns will be addressed such as areas that are identified as possible planting space but may not be ideal based on current conditions like being too small of space, retaining poor soil or dead foliage. Another concern is maintenance. Limbs and roots destroying other properties needs to be prevented. Also, various open areas that may be identified as possible planting space are intended to be left open for different reasons, possibly meant to be sports fields, water drainage, parking, or power or phone lines. We intend to identify the best possible planting spaces with regard to these conditions. Adding more to the urban tree canopy will help improve the environment.

9. Reference

Adobe Creative Cloud Plans, pricing, and membership. (n.d.). Retrieved February 20, 2023, from https://www.adobe.com/creativecloud/plans.html

ArcGIS pro pricing. Buy Now. (n.d.). Retrieved February 20, 2023, from https://www.esri.com/en-us/arcgis/products/arcgis-pro/buy

Bravo-Bello, J. C., Martinez-Trinidad, T., Valdez-Lazalde, J. R., Romero-Sanchez, M. E., & Martinez-Trinidad, S. (2020). Analyzing Potential Tree-Planting Sites and Tree Coverage in Mexico City Using Satellite Imagery. *Forests*, *11*(4). https://doi -org.libproxy.txstate.edu/10.3390/f11040423

Burghardt, K. T., Avolio, M. L., Locke, D. H., Grove, J. M., Sonti, N. F., & Swan, C. M. (2023). Current street tree communities reflect race-based housing policy and modern attempts to remedy environmental injustice. *Ecology*, *104*(2), 1–11. https://doi -org.libproxy.txstate.edu/10.1002/ecy.3881

Compare all Microsoft 365 plans. Microsoft. (n.d.). Retrieved February 20, 2023, from https://www.microsoft.com/en-us/microsoft-365/business/compare-all-microsoft-365-business-products-b?&ef_id=EAIaIQobChMIis7K2oWb_QIV5hXUAR3erwQqEAAYASAAEgL3uPD_BwE%3AG%3As&OCID=AIDcmm409lj8ne_SEM_EAIaIQobChMIis7K2oWb_QIV5hXUAR3erwQqEAAYASAAEgL3uPD_BwE%3AG%3As&lnkd=Google_O365SMB_Brand&gclid=EAIaIQobChMIis7K2oWb_QIV5hXUAR3erwQqEAAYASAAEgL3uPD_BwE

Kondo, M. C., McIntire, R. K., Bilal, U., & Schinasi, L. H. (2022). Reduction in socioeconomic inequalities in self-reported mental health conditions with increasing greenspace exposure. *Health and Place*, *78*. https://doi -org.libproxy.txstate.edu/10.1016/j.healthplace.2022.102908

Fletcher, D.H.; Garrett, J.K.; Thomas, A.; Fitch, A.; Cryle, P.; Shilton, S.; Jones, L. Location, Location, Location: Modelling of Noise Mitigation by Urban Woodland Shows the Benefit of Targeted Tree Planting in Cities. Sustainability 2022, 14, 7079. https://doi.org/10.3390/su14127079

Lin, J., Wang, Q., & Li, X. (2021). Socioeconomic and spatial inequalities of street tree abundance, species diversity, and size structure in New York City. *Landscape and Urban Planning*, *206*. https://doi -org.libproxy.txstate.edu/10.1016/j.landurbplan.2020.103992

Raciti, S.; Galvin, M. F.; Grove, J. M.; O'Neil-Dunne, J. P. M.; Todd, A.; Clagett, S. 2006. Urban Tree Canopy Goal Setting: A Guide for Chesapeake Bay Communities, United States Department of Agriculture, Forest Service, Northeastern State & Private Forestry, Chesapeake Bay Program Office, Annapolis, Md.

Salary.com, S. built by: (n.d.). *GIS manager salary in Austin, TX*. Salary.com. Retrieved February 20, 2023, from https://www.salary.com/research/salary/benchmark/gis-manager-salary/austin-tx

Salary.com, S. built by: (n.d.). *GIS technician/analyst I salary*. Salary.com. Retrieved February 20, 2023, from https://www.salary.com/research/salary/alternate/gis-technician-analyst-i-salary

Salary.com, S. built by: (n.d.). *Webmaster I salary*. Salary.com. Retrieved February 20, 2023, from https://www.salary.com/research/salary/alternate/webmaster-i-salary

Speak, A. F., Montagnani, L., Solly, H., Wellstein, C., & Zerbe, S. (2021). The impact of different tree planting strategies on ecosystem services and disservices in the piazzas of a northern Italian city. *Urban Ecosystems*, 1–12. https://doi -org.libproxy.txstate.edu/10.1007/s11252-021-01158-8

U.S. Department of Agriculture, Forest Service. 2019. Urban tree canopy assessment: a community's path to understanding and managing the urban forest. FS–1121. Washington, DC. 16 p.

Wang, J., Zhou, W., & Jiao, M. (2022). Location matters: Planting urban trees in the right places improves cooling. *Frontiers in Ecology and the Environment*, *20*(3), 147–151. https://doi.org/10.1002/fee.2455

Werbin ZR, Heidari L, Buckley S, Brochu P, Butler LJ, Connolly C, et al. (2020) A tree - planting decision support tool for urban heat mitigation. PLoS ONE 15(10): e0224959. https://doi.org/10.1371/journal.pone.0224959

10. Participation

Griffin Moore - Project Manager, Timetable, Methodology, Data, Research
Joseph Van Smirren – Graphic Design, Budget, Timetable, Research
Ashley Perez – Graphic Design, Conclusion, Research
Thomas Shively – Introduction, Literature Review, Research