

Sustainable Urban Enhancements: Community Forestry



Sustainable
Cities
Network

Arizona State
University

Project Cities



A Spring 2021
Collaborative Project with
Arizona State University's
Project Cities & the
City of Peoria



PART 1:

Project and community introduction

GET TO KNOW THE PROJECT

ABOUT ASU PROJECT CITIES

ABOUT THE CITY OF PEORIA

EXECUTIVE SUMMARY

KEY STUDENT RECOMMENDATIONS

SUSTAINABLE DEVELOPMENT GOALS

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This report represents original work prepared for the City of Peoria by students participating in courses aligned with Arizona State University's Project Cities program. Findings, information, and recommendations are those of students and are not necessarily of Arizona State University. Student reports are not peer reviewed for statistical or computational accuracy, or comprehensively fact-checked, in the same fashion as academic journal articles. Editor's notes are provided throughout the report to highlight instances where Project Cities staff, ASU faculty, municipal staff, or any other reviewer felt the need to further clarify information or comment on student conclusions. Project partners should use care when using student reports as justification for future actions. Text and images contained in this report may not be used without permission from Project Cities.

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Project Cities

ACKNOWLEDGMENTS

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On behalf of the Julie Ann Wrigley Global Futures Laboratory, the Global Institute of Sustainability and Innovation, and the School of Sustainability, we extend a heartfelt thank you to the City of Peoria for enthusiastically engaging with students and faculty throughout the semester. These projects provide valuable real-world experience for our students and we hope that their perspectives shine light on opportunities to continuously improve Peoria's future livelihood and community well-being.

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To access the original student reports, additional materials, and resources, visit:
links.asu.edu/PCPeoriaUrbanForestry20-21

ABOUT PROJECT CITIES

The ASU Project Cities program uses an innovative, new approach to traditional university-community partnerships. Through a curated relationship over the course of an academic year, selected Community Partners work with Project Cities faculty and students to co-create strategies for better environmental, economic, and social balance in the places we call home. Students from multiple disciplines research difficult challenges chosen by the city and propose innovative sustainable solutions in consultation with city staff. This is a win-win partnership, which also allows students to reinforce classroom learning and practice professional skills in a real-world client-based project. Project Cities is a member of Educational Partnerships for Innovation in Communities Network (EPIC-N), a growing coalition of more than 35 educational institutions partnering with local government agencies across the United States and around the world.

ABOUT SUSTAINABLE CITIES NETWORK

Project Cities is a program of ASU's Sustainable Cities Network. This network was founded in 2008 to support communities in sharing knowledge and coordinating efforts to understand and solve sustainability problems. It is designed to foster partnerships, identify best practices, provide training and information, and connect ASU's research to front-line challenges facing local communities. Network members come from Arizona cities, towns, counties, and Native American communities, and cover a broad range of professional disciplines. Together, these members work to create a more sustainable region and state. In 2012, the network was awarded the Pacific Southwest Region's 2012 Green Government Award by the U.S. EPA for its efforts. For more information, visit sustainablecities.asu.edu.

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ABOUT PEORIA

Ranked as the No. 1 place to live in Arizona by Money Magazine, the City of Peoria is currently home to over 191,000 residents. The City enjoys a reputation as a family-oriented, active community with an exceptional quality of life. Peoria entertainment and recreational amenities include attractions such as Lake Pleasant, trails, and community parks.

The City has also demonstrated a strong commitment to sustainability, as evidenced by its incorporation of LEED building design standards, a council-adopted Sustainability Action Plan, and the "Green Team" staff dedicated to managing organization-wide sustainability initiatives.

PEORIA TEAM

Project Cities Community Liaison

Sharon Roberson, Assistant to the City Manager, City Manager's Office

Peoria Project Leads

John Sefton Jr., Parks, Recreation, and Community Facilities Director

Jay Davies, Interim Public Works Director

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*Peoria is the place
World class ▪ Sustainable ▪ Future Ready*

peoriaaz.gov



City of Peoria

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July 7, 2021

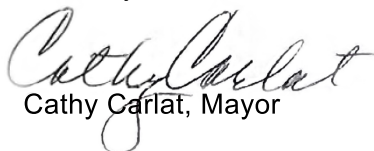
Dear Peoria community members,

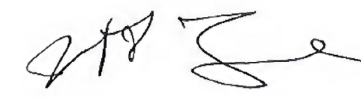
It is with tremendous appreciation and excitement that we bring to your attention the results of the second year of our collaboration with ASU's Project Cities program. Although it was a very different kind of year than the first year of our collaboration, that did not dampen the energy of the students or the final results of their work. This partnership has provided the opportunity to work with faculty and students across several academic programs, benefitting from their insights, creativity, and diverse perspectives on a number of projects. Many of these entailed public participation, and you may have participated by completing a survey that was distributed in our community through a variety of platforms.

Project Cities is one of several partnerships we enjoy with ASU, and part of our ongoing strategy to engage with community partners to leverage our resources as we address the many issues that face us as a local government. With a modest investment in this program, we have received extensive research, recommendations, and deliverables that take several key initiatives to the next level for us. These include our efforts around water conservation, transit, recycling, and the possibilities around our Skunk Creek corridor in P83. By engaging students and faculty on these subjects, we have advanced our understanding and positions on each one much more quickly than we could have without their assistance.

The results provided on each project provide us with invaluable insights into many of our most important opportunities, and will position us to better serve our community. The city has already begun to incorporate the students' deliverables into next steps in advancing these projects. We look forward to continuing this work on additional projects in the coming year, and cherish our partnership with ASU and Project Cities.

Sincerely,


Cathy Carlát, Mayor


Jeff Tyne, City Manager

Peoria, Arizona



Proud partner of

ASU Sustainable Cities
Network
Arizona State University

Project Cities

Rio Vista Recreation Center

Demographics

total population: **190,985**

median age: **35**

**highly skilled and educated workforce
of 85,252**

11,997 veterans live in Peoria

78% of residents are homeowners

median property value: **\$399,025**

**33% of residents hold a Bachelor's
degree or higher**

median household income: **\$79,700**

Schools

#3 of 131 Best School Districts for Athletes in Arizona

#5 of 40 Best School Districts in Phoenix Metro Area

#7 of 130 Best School Districts in Arizona

The Peoria Unified School District is one of the largest employers in the West Valley. The district consistently receives high ratings and offers signature programs such as the Career and Technical Education programs.

Peoria is also home to Huntington University, a liberal arts college offering digital media education in animation, broadcasting, film, graphic design and other digital media arts.

Leading industries

Peoria, Arizona is not just a scenic suburb of Phoenix, but also a thriving economic development hub with an educated workforce and high-end residential living. There are over 4,000 employers and more than 75,000 people employed within Peoria. Leading industries include health care and social assistance, retail trade, and finance and insurance. Highest-paying industries include utilities, manufacturing and public administration. Beyond these industries, Peoria works actively to attract businesses from aerospace and defense, film and digital media, technology and innovation, hospitality and tourism, and research and development. Peoria is the place for business owners, developers and investors.



Health Care & Social Work

10,905 employees



Retail Trade

10,628 employees



Finance & Insurance

6,574 employees



History

Founded in 1886 by Midwestern settlers, Peoria is nestled in the Salt River Valley and extends North into the foothills around Lake Pleasant. Beginning as a small agricultural town, the economy received a major boost when a railroad spur line was built along Grand Avenue. The construction of the Roosevelt Dam in 1910 secured a reliable water supply, attracting more settlers to the area and business endeavors to the town center. Peoria's economy continued to have an agricultural focus for decades. Continually growing, Peoria assumed city status in 1971 with a population of 4,792. It has since grown into a city with a population over 190,000, and is renowned for its high quality of life and recreational amenities.

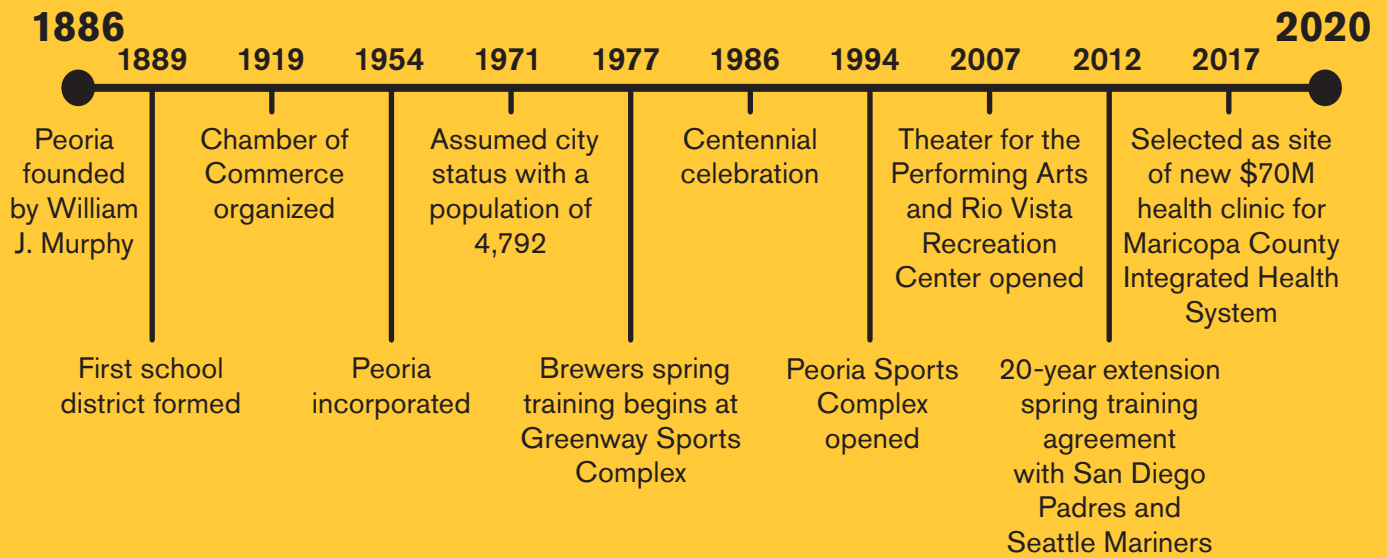
Sustainability

Peoria has demonstrated leadership in municipal sustainability efforts through a wide range of actions. Listed below are some of the City's sustainability accomplishments.

- Incorporation of LEED building design standards
- Appointment of a full-time city staff member who manages and coordinates sustainability initiatives
- Sustainable urban planning practices including open space planning and water management principles
- Sustain and Gain: Facebook page and brochures keep residents up to date on city sustainability efforts and ways to get involved
- Water Conservation Program: free public classes, public outreach at city events, and water rebate incentives for residents
- Council-Adopted Sustainability Action Plan: this strategic planning document, in its second iteration, ensures city departments are developing sustainability-oriented goals, tracking success metrics, and encouraging cross-communication in the preparation of Sustainability Update presentations made to the Peoria City Council on an annual basis
- Sustainable University: courses and workshops to empower residents to make small changes that make Peoria a better place to live; topics covered include residential solar, gardening, composting and recycling

Awards and recognition

- Number One City to Live, Work and Play in 2021 (*Ranking Arizona*)
- Received three Crescordia awards by Arizona Forward at the annual Environmental Excellence Awards in 2016
- 12th City for Green Space in the U.S. in 2019 (*Wallethub*)
- Top 15 Safest Cities in the U.S. 2017-2019 (*Wallethub*)
- 6th Wealthiest ZIP Code in 2020 (*Phoenix Business Journal*)
- Top 50 Hottest Hoods in 2018 (*Phoenix Business Journal*)
- 10th Best City to Raise a Family in 2018 (*Wallethub*)
- Top 100 Golf Course in U.S. 2017-2019 (*Golf Digest*)



Livability

Peoria is renowned as a great place to raise a family and start a career. A plethora of

local amenities and attractions contribute to Peoria's livability. Beyond the tourist attractions of Spring Training and Lake Pleasant, the City offers many community facilities and recreational opportunities for all ages and interests such as an extensive public park system and annual community events. Peoria's dedication toward livability is also evident in the City's latest General Plan which addresses sustainable water use, housing, public services and more.

Ranked as the No. 1 place to live in Arizona and one of the best cities in the United States.

-Money Magazine and Yahoo! Finance

Peoria strives to uphold these six major livability priorities in order to maintain an exceptional quality of life for its citizens.

	Arts, Cultural and Recreational Enrichment		Economic Prosperity
	Smart Growth		Superior Public Services
	Healthy Neighborhoods		Integrated Transportation

Community Facilities

- Peoria Community Center
- Rio Vista Recreation Center
- Peoria Sports Complex
- Peoria Center for the Performing Arts
- 39 neighborhood parks
- 2 libraries
- 3 swimming pools
- 5 golf courses
- 9 lighted multi-purpose ball fields
- 15 tennis courts

Peoria Sports Complex



Lake Pleasant

Urban ecology, ecotourism and recreation

Peoria is surrounded by the natural beauty of the Sonoran Desert and is home to Lake Pleasant, a 23,000-acre park and major recreational asset to the North Valley. The transient Agua Fria River and New River flow through Peoria, as do a multitude of washes and creeks. Most notable perhaps is Skunk Creek — known for the recreational trails running alongside it — which forges a connection between Peoria and Glendale. Northern Peoria is home to beautiful mountains and buttes including Sunrise Mountain, Calderwood Butte and Cholla Mountain.

Boasting over 300 days of sunshine annually, Peoria's ecotourism opportunities are a steady industry for residents and visitors. The City features over 60 miles of trails for walking, biking and horseback riding, as well as 570 total acres of accessible park land.

Lake Pleasant Regional Park contains a full-service marina, providing opportunities for water-oriented recreation such as kayaking, water skiing and even scuba diving. Visitors can also go horseback riding, take gliding lessons, hike, camp and more.



Skunk Creek



Pleasant Harbor

MAP OF PROJECT CITIES PARTNER COMMUNITIES IN THE GREATER PHOENIX METROPOLITAN AREA



 Peoria City Hall

 ASU campus



The following report summarizes and draws highlights from work and research conducted by MSUS culminating experience students in SOS 582 Sustainability Project Management and SOS 593 Applied Project, for the Fall 2020 and Spring 2021 partnership between ASU's Project Cities and the City of Peoria.

To access the original student reports, additional materials, and resources, visit:

links.asu.edu/PCPeoriaUrbanForestry20-21

EXECUTIVE SUMMARY

Arid communities such as Peoria are often in search of innovative and sustainable heat mitigation solutions. Urban forestry is a growing practice that can help reduce energy consumption, increase pedestrian comfort, and provide environmental benefits such as filtering pollutants from urban air. Under the guidance of Paul Prosser and Caroline Harrison, Master of Sustainability Solutions students Theo Anglin and Rett Evans explored the feasibility of a Community Forestry Program for the City of Peoria as their culminating experience project.

The culminating experience spans two semesters. The Fall 2020 portion of the project, summarized in Part 2 of this report, was conducted as part of **SOS 582: Sustainability Project Management**, focusing on planning strategies and foundational research. The Spring 2021 portion, summarized in Part 3 of this report, was conducted in **SOS 593: Applied Project**, and focused on survey data gathering and analysis, finalizing recommendations, and proposing future continuations of the project.

Students researched the feasibility and challenges of adopting a Community Forestry Program (CFP) in arid communities by investigating forestry and shade programs in other cities with similar climates, conducting a literature review, and interviewing industry professionals. This process includes identifying specific barriers and opportunities regarding implementation. Local input on urban forestry was also sought out, as students surveyed Peoria residents to help determine the community desire for a CFP.

Peoria will likely benefit from a comprehensive CFP, as an urban forestry program can help reduce environmental inequalities throughout the area, enhance urban form, promote walkability, and increase biodiversity in urban settings. A CFP also highlights Peoria's dedication to becoming a forerunner in the arena of urban planning, the intersection of social and environmental sustainability, and human health. Through their efforts in this sphere, Peoria can act as an example, and provide motivation, for other communities that are interested in pursuing a similar program. If implemented, the CFP can influence the development of Peoria for years to come.

KEY STUDENT RECOMMENDATIONS

Recommendations for planning and implementing a community forestry program	Read more
Begin developing a Community Forestry Program (CFP) that is equitable, responsible in regards to water usage and management, and outlines appropriate maintenance techniques for trees on municipal, commercial, and private properties.	pp.25-29, 32, 41, 44-46, 48, 52-57
Plan for the inclusion of climate-appropriate watering, optimal trimming, and timely removal and replacement of any damaged trees.	pp.28, 32, 48, 50-56, 58
Implement one or more community forestry pilot programs to help determine the effectiveness and public reception of proposed urban forestry methods. Courses of action could include planting trees in currently unshaded areas with high walkability potential, measuring heat across the city, determining what household demographics are most likely to feel the worst effects of urban heat, or creating a food forest.	pp.41, 46, 55-57
Consider continuation of the community forestry project with other students to expand on potential plan proposals, case studies, additional data gathering, or other helpful material.	pp.41, 46, 57
Enhance the Peoria 311 application by integrating CFP features into the app and making it more widely available on common app stores (i.e., Apple, Android, Google). Potential features can include options to report downed trees, or record locations where users would like more shade.	p.55
Create a forestry board or subcommittee on the Parks and Recreation board to advise tree maintenance staff and policy decision makers on forestry topics.	p.55
Consider hiring forestry consultants or appoint a dedicated staff member to focus on developing a forestry plan. This position could expedite implementation as well as serve as a spokesperson for local educational campaigns.	p.56
Establish key guidelines for the CFP such as requiring all bus stops to feature natural or artificial shade. Survey results from this report may help determine the community's highest priorities regarding the CFP.	pp.28, 36, 56-57
Install fruit trees in the urban landscape to provide shade as well as accessible produce. Advertising a citrus-lined walkway as a "food forest" could promote tourism and inspire discussions about sustainable and local food production. Any leftover produce could be donated to local food banks or shelters.	pp.41, 55
Increase maintenance transparency to help residents understand why trees may be removed. Suggestions include social media takeovers, a running blog, or other public resources for the community to become more familiar with urban forestry practices.	pp. 26, 28, 32, 48, 50-56

KEY STUDENT RECOMMENDATIONS

Recommendations for building public knowledge of community forestry	Read more
Communicate the environmental, social, and economic advantages of increasing urban shade through a Community Forestry Program (CFP). Make it clear to citizens that existing trees will be carefully maintained.	pp.24-29, 32, 36, 44-46, 54-57
Prioritize education, budgeting, and implementation timelines to best encourage initial development of the CFP. These actions are found to be more crucial than focusing initially on municipal code changes.	pp.54, 56
Produce accessible educational content to increase awareness of urban forestry benefits. Potential avenues include virtual or in-person classes, community center events, or video series.	pp.47, 54, 56

CITY OF PEORIA PROJECTS: ALIGNMENT WITH THE UNITED NATIONS'

SUSTAINABLE DEVELOPMENT GOALS

As the leading international framework for sustainable decision-making, the 17 Sustainable Development Goals (SDGs) lay out a path for partnerships toward global peace and prosperity. The SDGs provide a set of goals and metrics for project impact to be measured, offering an illustration of the benefits experienced by the cities, towns, and students who participate in a Project Cities partnership. For details on the SDGs, visit sdgs.un.org/goals.



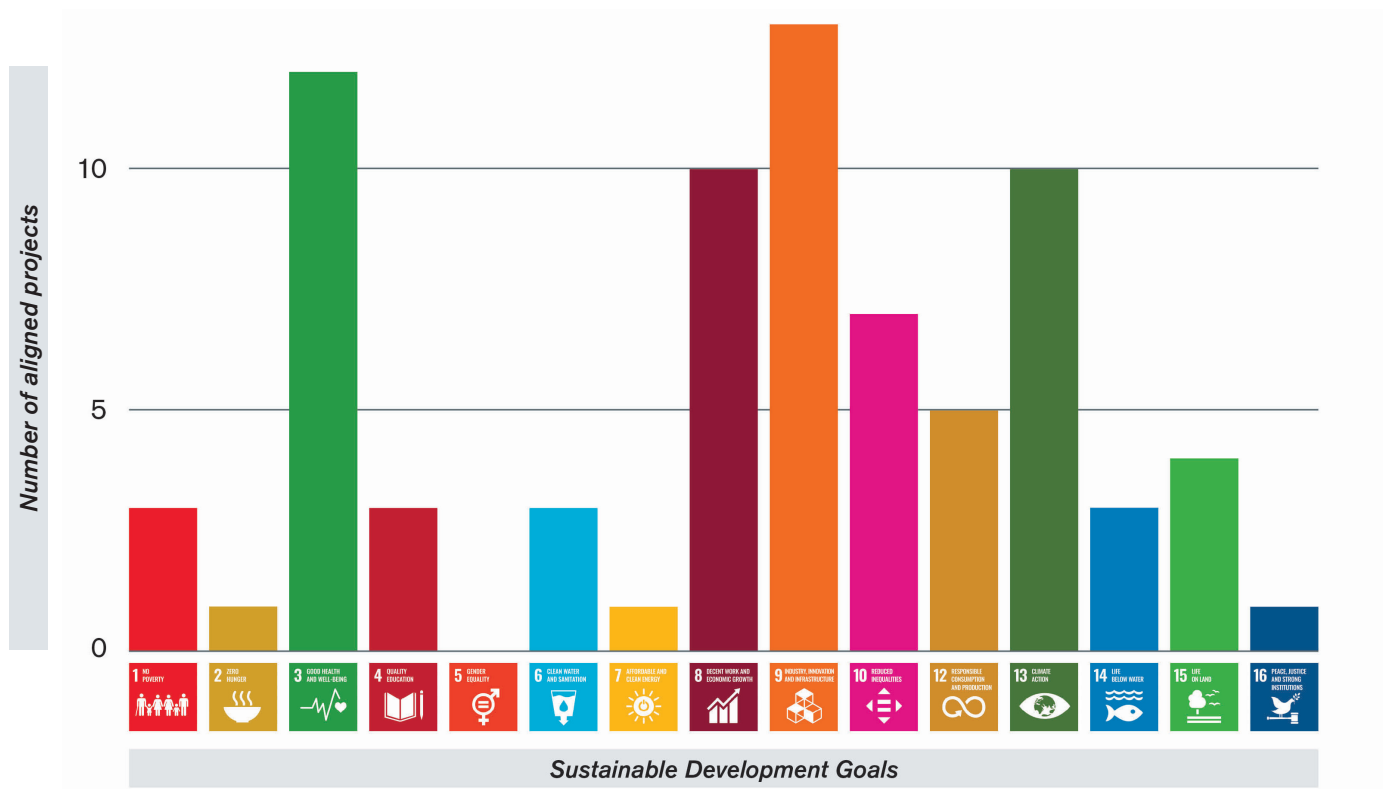
11 SUSTAINABLE CITIES AND COMMUNITIES



17 PARTNERSHIPS FOR THE GOALS

Every project in the PC program aligns with SDGs 11 and 17.

The figure below illustrates SDG project alignment throughout the City of Peoria's partnership with Project Cities, through the Spring 2021 semester.



TOP THREE GOALS ADDRESSED IN THE FOLLOWING REPORT

This project seeks to help Peoria in determining the feasibility, public interest, and potential benefits regarding a community forestry plan (CFP). This initial student research can help Peoria make informed decisions and determine next steps for increasing urban greenery in strategic locations throughout the city for health, comfort, aesthetic, and energy conservation purposes.



Goal 3: Good Health and Well-being

"Ensure healthy lives and promote well-being for all at all ages."

Increased tree canopy can help clean pollutants from the air, keep pedestrians cooler in summer months, and encourage more outdoor activity due to increased comfort.



Goal 13: Climate Action

"Take urgent action to combat climate change and its impacts."

Urban forestry can help combat the urban heat island effect, absorb greenhouse gases, and encourage residents to utilize alternative modes of transportation, lessening the reliance on automobiles and reducing emissions.



Goal 15: Life on Land

"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss."

Additional greenery can provide valuable habitat for native birds, insects, and mammals, especially in urban settings.

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PART 2:

Community Forestry Background and Proposal

**MSUS CULMINATING EXPERIENCE COMMUNITY FORESTRY
PROGRAM FINAL PROPOSAL**

SOS 582: SUSTAINABILITY PROJECT MANAGEMENT

SCHOOL OF SUSTAINABILITY

FACULTY

PAUL PROSSER

CAROLINE HARRISON

ACKNOWLEDGMENTS

Faculty

Paul Prosser

Caroline Harrison

Students

Theo Anglin

Joseph "Rett" Evans

Editors

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Lindsey Sikorski

Anne Reichman

Alison Almand

Peoria Staff Team

Brandon Putman

Ryan McCartney

Chris Calterra

Sharon Roberson

PROJECT NARRATIVE

Introduction

Extreme urban heat is an issue that plagues the arid cities of the desert southwest and is projected to intensify with regional climate change impacts (Grossman-Clarke et al., 2014). Due to the inherent risk of extreme heat to the area's habitability, cities have started to prioritize heat mitigation and adaptation strategies to protect residents. Urban heat is exacerbated by the Urban Heat Island effect, which occurs when roads and buildings absorb and radiate heat, often causing considerable temperature increases compared to non-urban areas (Grossman-Clarke et al., 2010). The City of Peoria, Arizona has recognized this issue as substantial and is pursuing an urban forestry initiative to reduce its impact. This Arizona State University (ASU) Masters of Sustainability Solutions (MSUS) project by Theo Anglin and Rett Evans aims to assess the viability of a potential community forestry program in Peoria by presenting concepts for shade and urban cooling projects to city officials, recommending policy changes that will improve Peoria's operational efficiencies, and identifying non-profit and business partnerships within Peoria that would assist in a program's creation, implementation, and maintenance.



Figure 1 Bird's eye view of West Valley cities Glendale and Peoria from North Mountain Park

The project will mainly address the problem of extreme heat and its implications across Peoria's vulnerable, low-income population in the south, and less vulnerable, higher-income population in the north. As temperatures are expected to continue rising in the Southwest United States (USGCRP, 2016), homeless and lower-income residents will be the most vulnerable populations to hazardous heat levels in the absence of adequate public infrastructure (Harlan et al., 2013). However, higher income residents likely do not experience extreme heat the same way, as they have more secure access to home air conditioning units and maintenance, cars with air conditioning, and other mitigation devices or strategies. In extreme heat, residents of all income groups will be overly dependent on motor vehicles and air conditioning, thereby exacerbating climate change through increased greenhouse emissions. Therefore, it is paramount for Peoria to address the problem of urban heat to ensure sustainable urban development in the future, as the city is expected to double in size in coming decades.

Problem identification

To distinguish extreme heat as a **sustainability problem**, students assessed the issue according to the criteria put forth by Dr. Arnim Wiek (Wiek, 2015). Extreme urban heat is significantly harmful in the long-term because it increases the incidence of heat related illness and death and has been documented to adversely impact infrastructure (Chuang & Gober, 2015). This existing issue is compounded by climate change, as average heat is projected to continue rising in the area (Grossman-Clarke et al., 2014). **In 2019, the Phoenix metropolitan region attributed 197 fatalities to urban heat**, and "those numbers are only expected to increase as the climate changes" (Kaplan 2020).

Editor's Note

Sustainability problems are generally considered to include issues that pertain to the overall environmental and societal wellbeing of communities.

The problem is urgent as the region is already being impacted by high temperatures, with the summer of 2020 being one of the hottest ever recorded in the Phoenix area. Without sufficient, immediate action, vulnerable populations will be increasingly burdened with extreme heat and may suffer from additional heat related deaths (Harlan et al., 2013).

Editor's Note

Extreme temperatures can cause fatalities in the form of heat stroke, heat exhaustion, heart attack, and other deadly conditions. Vulnerable populations, such as the elderly, those experiencing homelessness, and low-income individuals, are often more susceptible to heat-related deaths. This can be due to a myriad of contributing factors including pre-existing health conditions, inadequate shelter, or lack of heat mitigation resources, such as air conditioning or drinking water.

The effects of this problem are dispersed, as extreme heat is ubiquitous, yet represents greater risk to low-income residents who may not have access to a vehicle or cannot afford to run their air conditioning consistently. Extreme heat also adds additional stress to infrastructure which can increase maintenance costs to residents and taxpayers (Chuang & Gober, 2015). **Poverty is shown to be the foremost sociological factor that predicts vulnerability to extreme heat** (Harlan et al., 2013).

The causes of extreme heat are complex, arising from global climate change and decades of urban planning decisions. Regional planning decisions can amplify the urban heat island effect in one region and mitigate it in another, thereby influencing disparate perceptions of the enormity of the issue (Uejio et al., 2011).

Finally, the problem is potentially contested as some residents may not feel the burden of extreme heat as fully as others and may not prioritize heat reduction initiatives (Harlan et al., 2013). Some residents of Peoria may not be willing to accept urban heat as a problem, as doing so may result in redistribution of service funding due to budget reconfiguration.

Urban heat is recognized as a problem by the City of Peoria, and there is great opportunity in investigating the feasibility of a community forestry program. By reaching out to ASU and Project Cities, the City of Peoria has demonstrated a committed interest in increasing shade in its urban areas.

Enhancing infrastructure to mitigate and adapt to extreme heat is critical for the sustainability of the region. Assessing the viability of an urban forestry project helps tackle the root causes of urban heat. Increased shade decreases energy use associated with cooling buildings, and automobile reliance, thereby reducing emissions and climatic strain. This project addresses the immediate problem's causes by researching how to reduce residents' exposure to solar radiation and extreme heat, as well as reducing the Urban Heat Island effect. While the positive effects listed above will likely outweigh the negatives, it is important to note potential issues could arise regarding water resource strain, potential tree damage, and maintenance costs.

This project advances the career goals of both student team members as they are passionate about working with governments or businesses to pursue consulting work or work in the realm of urban planning. This initiative will provide students the experience of working with local governments as third-party consultants and developing urban plans.

Literature review

Peoria, Arizona experiences summers characterized by extreme heat, which is projected to worsen with the regional effects of a changing climate (Grossman-Clarke et al., 2014). Researchers utilized ten unique climate models to predict a feasible range of future temperatures, and determined that extreme heat events could increase by 6 to 20 times in the period from 2041-2070 (Grossman-Clarke et al., 2014). Meanwhile, the Phoenix metropolitan area is rapidly growing, leading to increased conversion of land use to urban forms and exacerbating the urban heat island effect (Grossman-Clarke, 2010). With the growth of the population due to urbanization and sprawl, there is an increased risk of heat vulnerability amongst residents, especially with the absence of adequate urban cooling (Harlan et al., 2013). However, researchers have determined that green infrastructure, such as parks and trees, has a notable cooling effect (Declet-Barreto et al., 2012). This is due to the direct provision of shade, and the evaporative cooling effect of transpiration (Declet-Barreto et al., 2012). A handful of cities in the Phoenix area have already taken action to increase shade coverage through tree planting programs.

Human health is often linked to urban heat in terms of comfort levels, heat-related illnesses, and death. The extent to which heat kills is often difficult to quantify, but Wang et al., in a study of 7 Canadian cities, found that an increase of Urban Heat Island intensity of 2–3 °C translates into a 4–7% increase in mortality rate (2016). Lives can be saved by planting trees, and as temperatures continue to rise, tree shade will be critical to ensuring safety in outdoor urban environments. However, it is paramount that installed trees are locally adapted and able to survive extreme heat.

The study by Deplet-Barreto et al. provides evidence that an increase in urban canopy through the implementation of Peoria's proposed urban forestry program is an effective means to mitigate urban heat, while also providing co-benefits such as beauty and clean air (2012). **Local vegetation density is a major indicator of heat vulnerability among neighborhoods, which is also closely tied to relative poverty** (Harlan et al., 2013). The aim of this project is to determine if a CFP can be established in Peoria. If the City decides to move forward with CFP creation, the plan should seek to equitably increase tree cover, providing ecosystem services and related co-benefits for all Peoria residents.

Students used public outreach techniques to gather resident concerns and preferences to inform Peoria officials on how to incorporate public vision into the program. An outreach approach supported by the literature review is a community-wide conference to discuss heat mitigation and promote dialogue among community leaders (Guyer et al., 2019). While novel outreach techniques will be applied due to the Coronavirus pandemic, it is possible that traditional barriers to public participation can be alleviated by the accessibility of online formats.

Researchers in Europe have identified several important considerations for public engagement in sustainability initiatives, including robust information sharing through media platforms, dedicated forums to facilitate engagement, and direct public access to the decision making process connecting local government and civil groups (Richard, 2018). Barriers to constructive public participation have been identified as an unwillingness to negotiate for collective solutions beyond special interests, and the lack of time afforded to trust building exercises (Richard, 2018). Despite these challenges, public participation is seen as a critical process in the development of long-term solutions and necessary for exercising democratic government mandates (Richard, 2018). To alleviate these issues, the student team will ask participants to indicate potential conflicts of interest in the distributed surveys.

Regional urban forestry

The City of Tempe, City of Phoenix, and the City of Peoria share similar climates due to geographic proximity. Tempe and Phoenix have demonstrated their commitment to local heat mitigation through the development of comprehensive shade plans and urban forestry. **Tempe's forestry plan identifies a need for collaboration between public and private landowners so that trees are planted where they are needed to provide shade, not just where it is convenient** (City of Tempe, 2017). Tempe identified the following barriers to the forestry plan's implementation: tree maintenance, water availability, viewshed reduction, property disputes, and stakeholder engagement (City of Tempe, 2017). An infographic from the City of Phoenix (Figure 2) gives statistics that are helpful for convincing citizens of the benefits of tree planting; for example, healthy trees can increase nearby home values of up to 10% and can reduce urban temperatures by 9 degrees Fahrenheit while simultaneously improving air quality (City of Phoenix, 2015).

Other benefits of urban forestry include; improved physical and mental health, increased energy savings, and amplified business to shaded commercial areas. For example, the City of Phoenix cites over 40 million dollars annually in general benefits on account of its urban tree planting (City of Phoenix, 2015). These two documents will be crucial for swaying Peoria public opinion of trees to be more positive, as team members can bring up the financial, physical and mental health benefits of adding trees to existing urban environments, particularly human-scale walkways.

Key takeaways

Taslim et al. (2015) compiles a number of general guidelines for mitigating urban heat in arid regions such as Peoria. Some of these planning guidelines include artificial shade provision, orienting new developments to shade walkways during the hottest parts of the day, and using region-appropriate vegetation to offset urban heat (Taslim et al., 2015). This compilation shows that urban green spaces provide more benefits than just shade; they clean the air and can provide a critical barrier between pedestrians and traffic, thus improving urban safety and creating a sense of well-being (Taslim et al., 2015).

By analyzing literature in the realms of urban planning, urban heat, and urban canopy, the student team is better equipped to understand the drivers of Peoria's urban heat, communicate more effectively with Peoria residents and partners, and present compelling statistics for forestry program creation.

URBAN TREE PLANTING

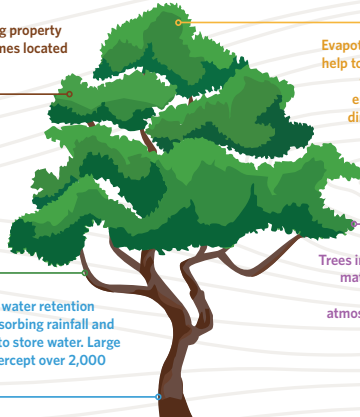
BENEFITS OUTWEIGH COSTS TO PHOENIX

Cities across the globe are seeing rising temperatures, in part, as a result of the Urban Heat Island (UHI) effect! This phenomenon is largely due to urban infrastructure like roads, buildings, and sidewalks re-emitting heat at night that they absorbed throughout the day. Now, more than ever, we need to start bringing Nature's valuable, cooling powerhouse into our cities – trees are back!

\$ Healthy trees can increase surrounding property values by 2-10%.² Apartments and homes located near a park have even higher values.

🌡️ Large scale vegetated areas can be as much as 9°F cooler than non-green city centers.^{2,11} Various functions of trees, such as their evaporative cooling effect, help to reduce urban heat island (UHI) effect and heat stress-related illness and fatalities.

💧 Trees provide significant storm water retention benefits by intercepting and absorbing rainfall and by increasing the ability of soil to store water. Large trees (~37 ft. crown spread) intercept over 2,000 gallons of rainfall annually.^{2,11}



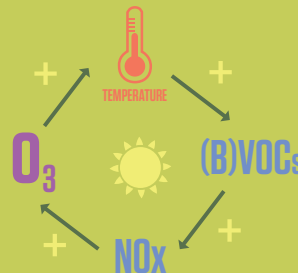
🌬️ Evapotranspiration and shade that trees provide help to cool down buildings and reduce the need for air conditioning, which then decreases energy consumption.^{2,11} Using less energy = direct costs savings for building owners and resource savings for the community.

🌿 Trees improve air quality by intercepting particulate matter (PM₁₀) and absorbing gaseous pollutants (NO_x, SO₂, and O₃).^{2,11} They also help reduce atmospheric CO₂ levels by capturing and storing it.

Trees and the Importance of BVOCs

Biogenic Volatile Organic Compounds (BVOCs)

- Ground level ozone forms when oxides of nitrogen (NO_x) and volatile organic compounds (VOCs) react in the presence of strong sunlight. Ozone is an air pollutant and contributes to increased temperatures. The highest levels of ozone are recorded during summer months. NO_x and VOCs are created by vehicles, industrial facilities, commercial products and solvents.⁴
- Less than 10 percent of VOCs originate from natural sources called BVOCs, biogenic volatile organic compounds. BVOCs are compounds emitted by all photosynthetic plants, including grasses and shrubs, as part of their metabolic processes.^{3,9,12}
- Tree and shade can help decrease temperatures and reduce ozone formation.
- Locally adapted, low BVOC-emitting trees can provide positive ecological services and benefits – contributing to better air quality and community health.



Examples of Low-emitting Trees for Phoenix:

- Acacia
- Ash
- Evergreen Elm
- Desert Willow
- Ironwood
- Palo Verde
- Pistache
- Pine

We have a choice: **Be Smart . . . Design Sustainably . . . Plant Wisely.**

TREES CAN BE TRUSTED

Green spaces help to **reduce stress** and **improve mental concentration**. Researchers have confirmed, through an EEG brain-wave study, that green spaces can actually **lessen brain fatigue**, making you feel **more calm and focused**.⁵



OTHER CITIES THAT VALUE TREES

New York City struggled with poor air quality due to harmful carbon emissions from vehicles and fossil fuel based power plants.⁶

In 2006, the City of **Los Angeles** only had 21% tree canopy coverage.⁷ The national average is 27%.

In recent decades, **Philadelphia** has lost a significant number of trees to development and sprawl.⁸



New York has increased its urban forests by 20%, extensively cutting down on harmful air pollutants and saving them an astounding \$220,000.⁶

When **Los Angeles** started planting more trees, it saw improvements in mental health, lower energy costs, and increased consumer spending in tree-filled commercial areas.⁷

As a counter to high pollution levels, **Pennsylvania Horticultural Society** has pledged to restore lost canopy coverage by adding about 30% more trees.⁸

ANNUAL BENEFITS TO PHOENIX

91.7
Million cubic feet of storm runoff avoided⁹

1,700
Tons of air pollution removed⁹

89,200
Tons of oxygen produced⁹

35,400
Tons of carbon sequestered
In addition to the 305,000 tons already stored in existing trees⁹

VALUE OF PHOENIX'S URBAN FOREST

RETURN ON INVESTMENT

\$2.23 PER TREE

A medium-sized tree at maturity.¹⁰

TOTAL BENEFITS

\$40.25 MILLION

Annual combined benefits of existing Phoenix urban forest.¹⁰

REPLACEMENT COST

\$3.84 BILLION

Cost to replace Phoenix urban forest.¹⁰

Figure 2 Urban Tree Planting infographic by ASU Fall 2015 SOS 498/594 students, full document available at www.phoenix.gov/parkssite/Documents/PKS_Forestry/PKS_Forestry_Infographic_Urban_Forestry_Benefits_Costs.pdf

Project plan

This project consists of three distinct phases: community engagement, policy analysis, and recommendations.

Community engagement

Survey Peoria residents to determine their current position on urban forestry. Students will assemble a diverse focus group, distribute surveys, and provide examples of landscape plans for citizens to vote on. The team will then compile responses and use them to guide project development.

Policy analysis

Identify and analyze policies of other desert cities in regards to urban forestry. Students will compare results to Peoria's existing code and generate recommendations on how the code could be modified to better achieve the City's goals.

Recommendations

Compile and present all prior research to propose recommendations to Peoria on how to best move forward, while addressing the citizens' concerns and preferences.

Because this project assesses the feasibility of developing and implementing a community forestry program in Peoria, communication with residents and stakeholders within the city is key. Communicating with these individuals and groups requires the use of Zoom and other electronic resources for the duration of the COVID-19 pandemic. The project approach follows a **Transition Management governance** approach using Wiek's solution framework (Wiek, 2015) and may require tools such as GIS, Photoshop, Insight Maker, and public commentary transcription and analysis.

Editor's Note

Transition Management is a governance model often used in sustainable development projects that are focused on accelerated change and impacts. It highlights the importance of participatory visioning, research, and experimentation. This concept is further discussed in Arnim Wiek's book *Solving Sustainability Problems* listed in this report's References section.

The project plan was initiated by reaching out to project partners; teammates will be holding bi-weekly or weekly Zoom or Microsoft Teams meetings as needed with City of Peoria representatives in which project updates and research will be shared throughout the Spring 2021 semester. This process will culminate to the proposal of recommendations to Peoria's budgeting and legislative departments. The next step involves Peoria deciding if, based on the student research, a community forestry program is a suitable goal for the City to pursue in protecting its citizens. Peoria will be informed by write-ups and graphics the team develops to convey best strategies and designs.

The client for this project is the City of Peoria and students are working in conjunction with Scott Cloutier from the School of Sustainability, Steve Russell from Project Cities, and Chris Calcaterra, Jay Davies, Brandon Putman and Ryan McCartney from the City of Peoria. The primary stakeholders are the residents of Peoria, both current and future. The project was initiated by the City of Peoria and is supported by Arizona State University and Project Cities. Students will need to develop an understanding of landscape architecture, permaculture, edible forests, local needs, GIS, Photoshop, and Peoria's existing plans, infrastructure, and budgets to effectively execute the proposed project.

There are three primary deliverables for this project:

1. **Identify** and present concepts for Pedestrian and Shade Action Plan projects for consideration in the Capital Improvement Program budgeting.
2. **Recommend** policy and standard changes that improve operational efficiencies.
3. **Identify** mutually beneficial, on-going partnerships with nonprofits and Peoria businesses.

By providing these resources to Peoria, the city will be able to make an informed decision on next steps regarding community forestry program creation and implementation. Success will be generally assessed using Wiek's framework for project solutions.

Pedestrian Shade Action Plan concepts will be compiled and assessed based on the three pillars of sustainability; their economic feasibility, social implications, and environmental impacts (Figure 3). Using the three pillars of sustainability to grade concepts will help students to make informed decisions to present to the City, as the three pillars represent an “integrative process and framework for decision-making on undertakings that may have lasting effects” (Gibson 2006). Concepts will be identified through research and reading of urban shade guides in cities similar in some factor (climate, demographic, etc) to Peoria.

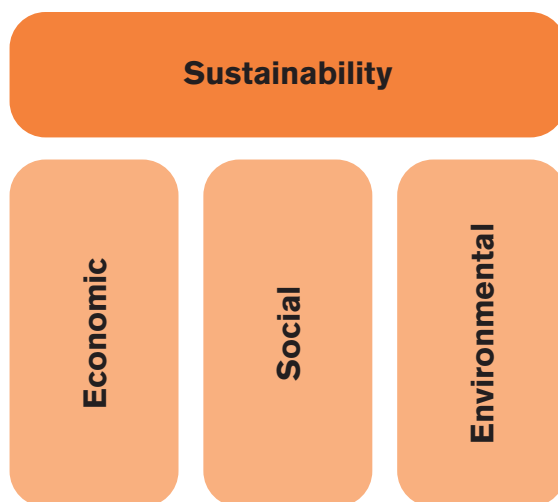


Figure 3 The pillars of sustainability are a common way of describing the three main components of sustainability, also sometimes referred to as "people, planet, and profits"

Ideally, a sustainable community forestry program should minimize resource inputs while maximizing shade and ecosystem service output. Inputs include land, water, building materials for shade structures, space, and the time and cost of maintenance. In Part 3 of this report, students research best practices for reducing current input rates so that additional shade can be provided in the near future in a more efficient and effective manner. A document listing actions that can improve the state of sustainability and their consequences is also compiled in Part 3 by using a similar Three Pillars assessment guideline to the one stated above.

Mutually beneficial, on-going partnerships will be created through this project to involve the Peoria community in the creation of future shade as well as provide financial and intellectual support for the program.

Partnerships are identified by reaching out to high-visibility businesses and organizations within Peoria and showcasing how their support could lead to better well-being of Peoria residents and tourists, which could then feed back into support of said business/organization. Participation in the partnership will not be demanded, only suggested, with solid research to show the mutually beneficial nature of said partnership and how businesses can showcase their local efforts through signage or a city certification policy. The main method used to identify and communicate with businesses is the 5-step guide Forbes suggests for business partnerships (Sweeney, 2013).

Partners, stakeholders, and subject matter experts

A number of subject matter experts at ASU helped guide the project. Experts were selected mainly for their experience in urban heat, planning, urban greenery/forestry, and public policy. All experts listed below agreed to be contacted when needed throughout the project's course for general assistance, ideas and opinions. Theo and Rett have already learned from some of these experts about planning and sustainability concepts, and how the two subjects are fundamentally tied together.

Paul Coseo

Assistant Professor in The Design School and Herberger Institute for Design and the Arts

Professor Coseo's focus is in adaptation to urban heat and how it can be influenced by urban design. Theo has worked with Professor Coseo on previous projects involving planning and landscape design.

David Sailor

Director of the Urban Climate Research Center and Professor in the School of Geographical Sciences and Urban Planning

Professor Sailor's work is at the intersection of climate and the built environment and he has done thorough research into solutions to the Urban Heat Island effect.

Jason Kelley

Lecturer in the School of Geographical Sciences and Urban Planning

Both students have had classes with Professor Kelley, whose work is in sustainable urban planning and design, environmental justice, and pedestrian-oriented urban development.

Scott Cloutier

Assistant Professor in the School of Sustainability and College of Global Futures, and is on the MSUS committee

Students were able to work with Professor Cloutier when initially defining their project. His expertise is in neighborhood/community development and happiness.

Michael Schoon

Associate Professor in the School of Sustainability

Rett has taken coursework by Professor Schoon, who does work in policy and governance, decision making, and complex adaptive systems.

Final thoughts

In the short-term, this project presents the opportunity to assess and develop the team members' sustainability and urban planning competency. In the long-term, it can provide significant benefits to the residents of Peoria through smart growth and innovative infrastructure. Key tasks and challenges include mediating expectations, clear communication, working within the given time-frame, and pushing one another to succeed.

PROJECT MANAGEMENT INFORMATION

Project purpose and objectives

The purpose of this project is to assess whether the City of Peoria would benefit from the development and implementation of a community forestry program. Assessment is done by creating a focus group of passionate Peoria residents and communicating with the larger city population through online surveys. This will help group members determine public stance on shade, urban heat, and community forestry. Following this, group members will create matrices comparing nearby Phoenix metropolitan area and regional desert cities to Peoria in terms of urban forestry feasibility and logistics, benchmarking where Peoria is compared to similar environments. This is intended to help Peoria stakeholders determine the level of investment needed for Peoria to attain similar forestry programs and sustainability. Finally, using the information gathered, members will present three deliverables to the City of Peoria:

1. **Identify** and present concepts for Pedestrian and Shade Action Plan projects for consideration in the capital Improvement Plan budgeting.
2. **Recommend** policy and standard changes that improve operational efficiencies.
3. **Identify** mutually beneficial, on-going partnerships with nonprofits and Peoria businesses.

This project aims to assist Peoria in making informed decisions on whether to begin creation of a community forestry program. Whichever route Peoria chooses to take—implement a program or change no aspects of the current tree canopy—will have its own risks and benefits to the city, natural resources and land, and Peoria residents.

Project stakeholders

As a collaboration between the City of Peoria and ASU MSUS students, the project stakeholders are Peoria residents, the Peoria planning and budgeting departments, and Peoria project lead Brandon Putman and his team. Peoria's mission statement is: "The city of Peoria provides excellent municipal services by anticipating community needs, creating partnerships, promoting sustainability and embracing diversity"; its vision statement is "We serve with integrity, embrace diversity, and are responsible stewards of taxpayer dollars and the natural environment." Through these two crucial statements, it is evident that Peoria cares about the natural environment it inhabits.



Figure 4 Lake Pleasant, situated in northern Peoria, is another example of the City's care and admiration for its natural assets, image by City of Peoria

Sustainability outcomes

Environmental outcomes

By researching urban forestry best practices, team members can determine general guidelines to propose to Peoria. Guidelines touch on water conservation, land use, and biodiversity. If Peoria moves forward in the creation of a Community Forestry Program (CFP), the local area will be cooled and shaded, benefiting native insect and animal species as well as cleaning the air.

Financial outcomes

Students will present their data for budget consideration. It is likely, based on preliminary research, that a CFP in Peoria would be expensive up-front but eventually “pay itself off” through reduced air conditioning usage and energy costs, less automobile reliance and gas consumption, and fewer damages to temperature sensitive infrastructure. The City of Peoria will have to determine if there is availability within its budget to create a community forestry program; offering a variety of options for the City to choose from will allow them to make an informed decision.

Social outcomes

Residents of Peoria may feel validated that the City wants to be informed of their opinions when considering a community forestry program. This could enhance social cohesion within the community. A community forestry program can benefit residents’ health and happiness by making it easier to walk or bike, as well as assist in protecting them from dangerously high temperatures.

Description of frameworks, tools, and methods

Throughout the project, students will employ Dr. Arnim Wiek’s solution framework as a guiding tool. The framework comprises a phased approach consisting of problem identification, problem analysis, solution vision, solution strategy, and implementation. The team selected this framework because it offers ample structure throughout the project process. The sustainability outcomes previously described inform the vision segment, which will guide the team’s actions throughout the process. An essential aspect of this approach is determining the systemic structure that reinforces the issue and identifying the root causes and actors. The team will use this lens to investigate the barriers to public participation in planning initiatives and will work to make commentary more accessible to Peoria residents.

Next, the team will use virtually-adapted public outreach to gauge the citizen’s current perception of urban forestry and to ensure that all perspectives are accounted for and addressed. The team will compile the results of the outreach initiative to inform city officials on how the project should be presented to the public. All comments are considered equal and project goals are to be determined democratically by the public majority. The team will strive to propose an equitable solution that considers and alleviates all concerns to ensure the sustainability of the program. Success will be measured by the extent of public participation across demographic groups and the subsequent integration of comments into the finalized program.

Risk matrix

A risk matrix (Figure 5) is a common tool used in risk assessment. The table helps define risk by comparing probability and impact to assist in decision-making.

		Severity			
		Low (1)	Medium (2)	High (3)	Very High (4)
Probability	Very High (4)	4	8	12	16
	High (3)	3	6	9	12
	Medium (2)	2	4	6	8
	Low (1)	1	2	3	4

Figure 5 Risk matrix values used to define internal and external risk assessments throughout the project

The following figures include risk assessments, aimed at defining and mitigating project risks in reference to the students (internal) and the City (external).

Internal risk assessment				
<i>Description</i>	<i>Probability</i>	<i>Impact</i>	<i>Rating</i>	<i>Mitigation</i>
Limited prior knowledge of Peoria	High	Low	Medium	Team will work closely with Peoria officials and will research demographics.
Limited urban planning experience	High	Medium	Medium High	Team will stick to project scope and work within capabilities.
Insufficient budget	Low	High	Medium	Team will predict all expenses and monitor closely. Will request assistance from Project Cities if necessary.
Internal conflict	Low	High	Medium	Team will identify and mediate potential conflicts.
Communication inconsistency	Medium	High	Medium High	Team will adhere to communication plan and members will hold each other accountable.
Time limitations	High	High	High	Team will adhere to the Gantt chart and will communicate all conflicts at least one week in advance.
Laptop malfunction	Low	High	Medium	All documents will be backed up in Google Drive. Campus resources will be utilized.

Figure 6 Project internal risk assessment

External risk assessment				
<i>Description</i>	<i>Probability</i>	<i>Impact</i>	<i>Rating</i>	<i>Mitigation</i>
Lack of public engagement	Medium	High	High	Various channels will be used to solicit participation.
City department budget cuts	Low	Medium	Medium	Associated costs will be minimized.
Communication disruption	Medium	Medium	Medium	Team will follow a set schedule to continue work without delay. If sever, the team will communicate with a different liaison.
Public disapproval	Low	High	High	Public concerns will be addressed and the final deliverable will be modified accordingly.
Coronavirus severity	Medium	High	Medium High	In-person events will be transitioned online.

Figure 7 Project external risk assessment

Project tracking tools

Students developed a detailed Gantt chart and flexible work breakdown structure (WBS) flowchart to guide and track the project (Figure 8). WBS components were derived from the project scope provided by Brandon Putman and the City of Peoria. The full Gantt chart is available in the original student content at links.asu.edu/PCPeoriaUrbanForestry20-21.

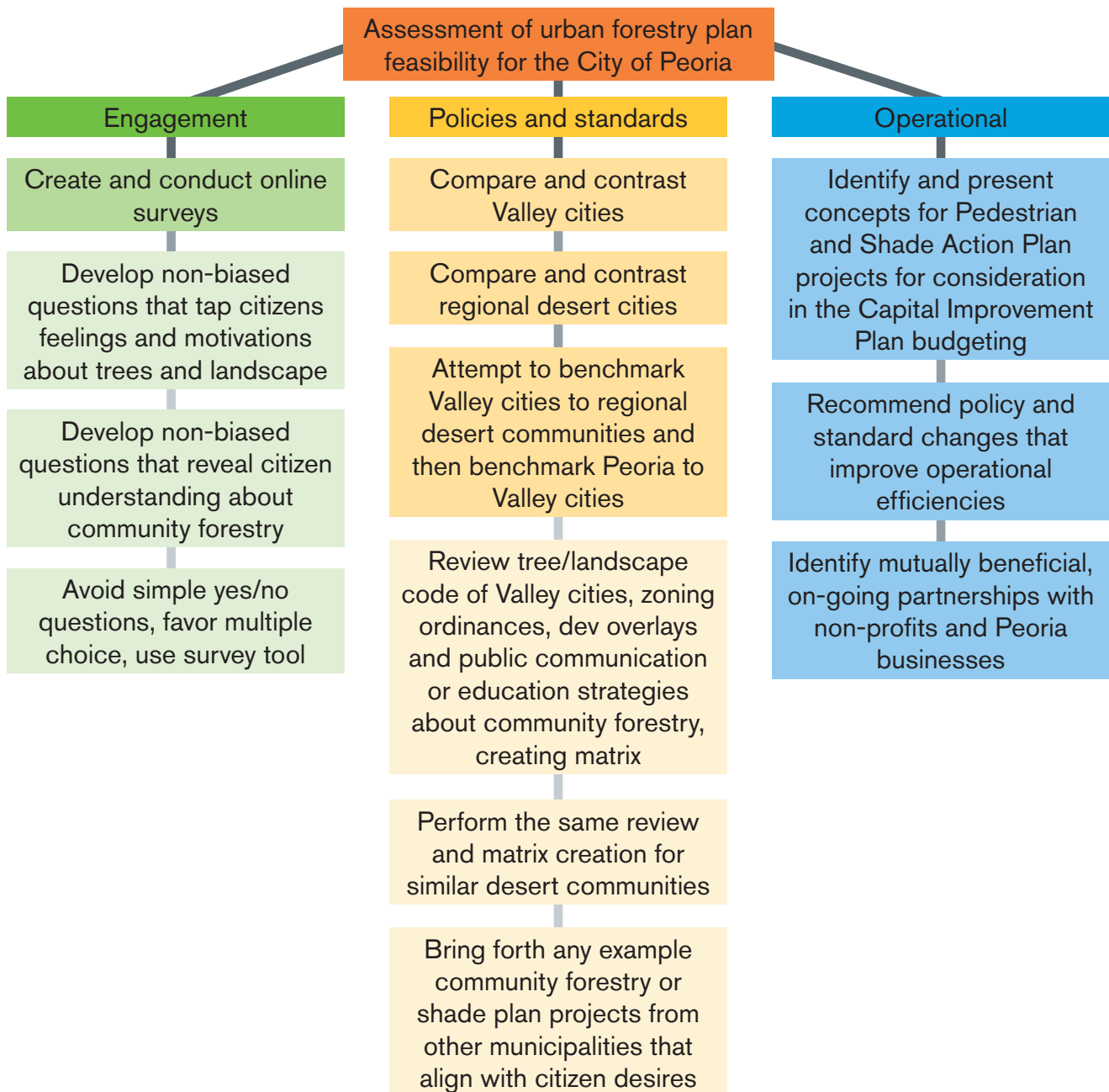


Figure 8 Summarized work breakdown structure (WBS)

Spring semester communication plan

Primary project communication in the Spring 2021 semester will be facilitated through Brandon Putman at the City of Peoria. Formal meetings will be held every other week. Communication will inevitably be hindered by the COVID-19 pandemic; most, if not all, communication with stakeholders and Peoria residents will be done virtually via email, Zoom, and/or Microsoft Teams. This has a high likelihood of reducing resident engagement, which may hinder information collection. It is important to note, collected information may not represent the entire population and its stance on urban forestry's risks and benefits.

Subject matter experts (SME) stated their intent to help the team by sharing applicable research, proofreading, offering suggestions for deliverables and presentations, and brainstorming solutions. Because their input will not be needed at a consistent rate throughout the project, formal communication plans have not been created with them.

Summary communication plan					
<i>Audience</i>	<i>Message</i>	<i>Actions</i>	<i>Method</i>	<i>Dates</i>	<i>Accountability</i>
Student team	Next steps, feedback, decision-making	Ensure work is up to date and realign project if issues arise	Text and Zoom	As needed, but typically bi-weekly	Theo and Rett are both responsible for maintaining communication
Client	Sending drafts, discussing successes or issues, generally staying updated and in touch	Update clients on progress made and ask for clarification or assistance	Zoom, Microsoft Teams, and email	Bi-weekly meetings on Wednesday at 3:00pm (Zoom), emailing at least once per week	Rett is responsible for setting meetings, Theo is responsible for maintaining email communication
Faculty	Progression of project and sharing of any successes or problems	Inform decision making through professors' feedback	Zoom and email	Zoom (once per week in class), email when needed	Theo and Rett are both responsible for sharing progress or concerns as needed

Figure 9 Summarized spring semester communication and engagement plan

Closing out the project

The initial planning and proposal section of this report was a vital step to progress the urban forestry project. The proposal will be completed when MSUS students Theo and Rett submit the final deliverables to the City of Peoria at the close of the Spring 2021 semester. If Peoria decides to move forward with the creation of a community forestry program, another MSUS student or group in next year's cohort could have the opportunity to build upon the findings in this report and assist Peoria in developing a substantial pilot program that allows it to stand out as an exemplary sustainable urban area. This pilot program could include planting trees in unshaded areas with high walkability potential, measuring heat across the city and determining what household demographics are most likely to feel the worst effects of urban heat, or creating a food forest using trees with large canopies. A pilot program (or multiple programs) could help the City of Peoria determine the effectiveness of proposed urban forestry programs and make a tangible impact on the urban landscape and human livelihoods. When the project is completed, and if the City of Peoria is interested, the team can transfer all documents associated with the project to the City. The following sections of the report (Part 3) details the student work conducted in the Spring 2021 semester, including research, findings, and recommendations for the City.

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PART 3:

Community Forestry Analysis and Next Steps

**MSUS CULMINATING EXPERIENCE COMMUNITY FORESTRY
PROGRAM FINAL REPORT AND RECOMMENDATIONS**

SOS 593: APPLIED PROJECT

SCHOOL OF SUSTAINABILITY

FACULTY

PAUL PROSSER

CAROLINE HARRISON

INTRODUCTION AND BACKGROUND

Peoria brought this project forward to the School of Sustainability with the scope already established. The City has a tree inventory and a sustainability plan, yet is interested in developing a Community Forestry Program (CFP). A CFP can help provide equal opportunities for shade, which increases transportation options and creates a safer walking environment in the hot summer months. In addition, increased shade can help improve air quality along walkways and alleviate the Urban Heat Island effect. Implementing a CFP could also stimulate Peoria's economy by providing a comfortable, shaded environment for shoppers, and a pull force for new business development.



Figure 10 Shaded sidewalks like this one in Phoenix, Arizona, can provide more comfort for pedestrians and encourage foot-traffic for nearby businesses

If Peoria does decide to create and adopt a CFP, the urban environment would likely change for the better. Cooler temperatures would allow for greater outdoor leisure and exercise, and the urban landscape would be more vibrant and appealing to spend time in. **Connectivity between walkable areas would also be improved** as pedestrians could travel comfortably for longer distances on pathways that are not only shaded, but are beautiful and protected from traffic by the natural infrastructure trees provide.

This project confronts the sustainability issues of excessive urban heat, low walkability, and societal inequalities due to urban economic and social disparities. These problems are common across many cities around the world, and this project can help provide a pathway forward for them. Through helping the City determine if a CFP is a worthwhile investment, we can also demonstrate to adjacent cities that the benefits trees bring to a city are numerous. If more cities invest in CFPs, they would likely become more resilient to climate change, become better places to live in terms of equality and happiness, and benefit from the financial value that urban canopies produce.

Urban sprawl is perpetuated in Peoria by market conditions that are favorable to development and automobile-centric infrastructure. Urban sprawl is not only more expensive to construct, it is also more difficult and costly to maintain. If Peoria continues forward with status quo development, it can have significantly negative implications for the three pillars of sustainability (environmental, social, and economic). The local environment can suffer from rapid urbanization and destruction of native desert landscape, and society can suffer from lost time spent commuting and being disconnected from other residents and family members. The economic implications are more debatable, yet increased population density can spur local economic activity. While it is unlikely that a CFP would be able to solve these problems, it can at minimum contribute to a more desirable future state. The CFP can also make the city more beautiful and safe, making Peoria a more desirable place to live and raising property values. To make these changes more robust, the City could also focus on zoning for increased density and access to commercial areas.

As noted in Part 1 of the report, the pathways to determine if a CFP was best for Peoria were already fairly solidified in the project scope, however students used Weik's solution framework to ensure recommendations are truly sustainable. Students also worked directly with stakeholders, the citizens of Peoria, to learn about what aspects of a CFP are most and least desirable, as well as where the most impact can be made, through a survey put out by the City of Peoria.

PROJECT APPROACH AND INTERVENTION METHODS

The current project approach is to extend public participation opportunities to Peoria residents so that they can inform the development of the Community Forestry Plan (CFP). By gathering citizen's preferences through a survey, students hope to increase public buy-in and to ensure that the project is aligned with the resident's vision for the future of the City (Richard et al., 2018). If the CFP is implemented, a multitude of environmental benefits including urban heat mitigation and air quality improvements are expected (Declét-Barreto et al., 2012). **The CFP is expected to improve social conditions by increasing walkability in the warmer months and by making the distribution of urban green space more equitable** (Taslim et al., 2015). Additionally, the CFP is expected to spur business development and to attract commerce in improved areas. By gathering and responding to the citizens' perspectives, the implementation will be more aligned with their values and will face fewer barriers. Therefore, the benefits of the CFP to the future of Peoria can materialize more expeditiously. By helping the city consult its residents and take their suggestions seriously, the team expects greater community buy-in and improved project efficacy.

By learning directly from Peoria residents about CFP desirability, as well as by conducting research and creating matrices on Peoria's ability to create an adequate CFP, students can recommend what Peoria's CFP should entail if adopted. If Peoria approves the CFP, next years' MSUS cohort could potentially work with the City to run pilot projects that can help iron out inefficiencies and add more data catered to the approved CFP. Transition management approaches, as well as Wiek's sustainability problem solving, solution strategy and problem identification frameworks have all been incorporated into this project. Performance will be evaluated by comparing the final results with the expectations laid out in Part 1 of the report, the project proposal.

Editor's Note
Complete peer community comparisons are available in the appendix of the Spring 2021 original student report at links.asu.edu/PCPeoriaUrbanForestry20-21.

The matrices produced for Peoria in the following sections include information about code and tree shade plans from cities within the Phoenix metropolitan area (such as Chandler, Phoenix, and Tempe) as well as outside the area (such as Tucson, Albuquerque, and San Antonio). By analyzing this information and comparing it to results gathered from the public survey, the team identified forestry plan success tactics and intervention points which are incorporated into the final CFP recommendations.

FINDINGS

Before the final CFP online survey results were available, students analyzed existing information from the City of Peoria Sustainability 3.0 Plan Resident Survey conducted by EMS 588 Master of Sustainability Leadership students. Specifically, some initial data on citizen perceptions regarding the urban canopy and trees was of value to the project (Nelson et al., 2021). One of the open-ended questions asked: **“What actions or goals do you feel are important for successful community engagement and education related to sustainability and conservation in Peoria?”**. Several responses referenced the need for investment in tree plantings and shade; for example, “We need to invest in ways to wisely use water, cool down the city, plant more native trees and shrubs”, “encourage people to buy a tree and have a plaque installed--have some labels and info about trees around town”, and “Holding classes to teach about options to be more sustainable at home (in person or online web based class) with an opportunity for a free plant, seeds, or tree to grow”. In response to a question asking what sustainable transportation goals are important for Peoria’s future, one person said “Who wants to wait for a bus in the heat? Plant more trees”.

Editor's Note
Full survey results are available in the "Additional Materials" folder at links.asu.edu/PCPeoriaUrbanForestry20-21.

Question 10 (Figure 11) in the sustainability survey asked: **“Which statement best describes your understanding of the phrase 'community forestry' as it relates to the Peoria Sustainability Plan?”** The majority of respondents (71.1%) selected that “the community forest consists of trees and vegetation located throughout Peoria that have a special relationship to people contributing to Peoria's ecosystems, sustainability, and community well-being”; the following question, which asked how important financial and temporal commitments to a tree recovery project are to the community, saw an impressive response of “extremely important” (54.7% of respondents).

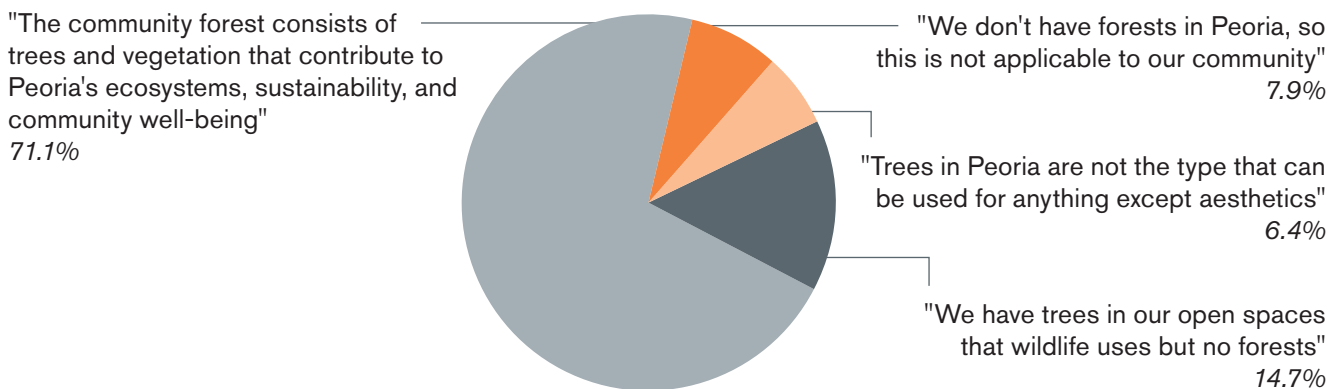


Figure 11 "Which statement best describes your understanding of the phrase 'community forestry' as it relates to the Peoria Sustainability Plan?" n=546

In addition, Question 14 (Figure 12), “What do you feel are important actions for the ongoing health and growth of natural ecosystems and community forestry in Peoria?” gathered numerous open-ended responses from Peoria citizens that highlight the necessity of trees for shade and that there is a general understanding of the tradeoff between water conservation and tree planting, as well as the importance of proper maintenance for forestry success and aesthetic satisfaction. This survey suggests that the majority of Peoria residents are not only knowledgeable about the importance of an urban forest, but they are also ready to support one.



Figure 12 Word cloud generated by responses to survey question 14, "What do you feel are important actions for the ongoing health and growth of natural ecosystems and community forestry in Peoria?" n=314

CFP online survey results

Editor's Note

The CFP online survey was infiltrated by bots which generated over 500 invalid responses. The bot responses were detected at the close of the survey and filtered out of the final results. All final figures presented in this report represent only viable community responses.

At the close of the CFP online survey, 169 viable community responses were recorded. The respondents represent a diverse group from low to high income, 18 to 70+, and different ethnicities. Gender distribution was nearly 50:50. The following figures highlight survey respondents' demographic information.

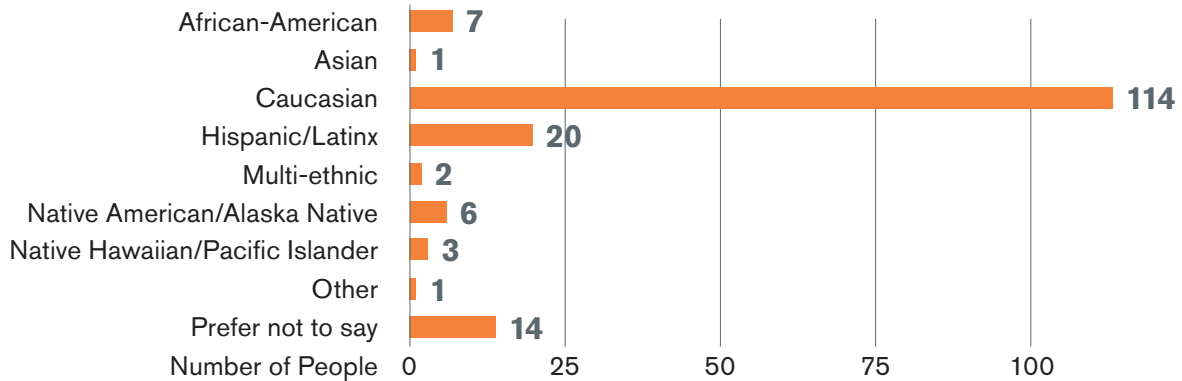


Figure 13 "Which of the following best describes your race or origin?"

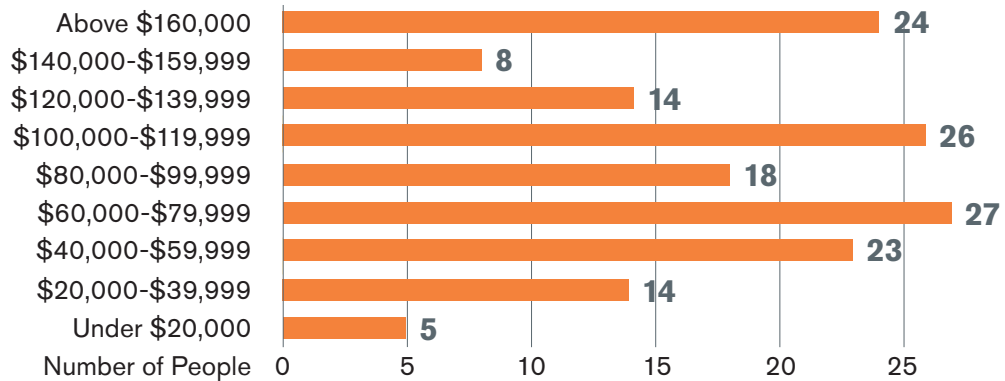


Figure 14 "Which statement best describes your 2020 annual household income?"

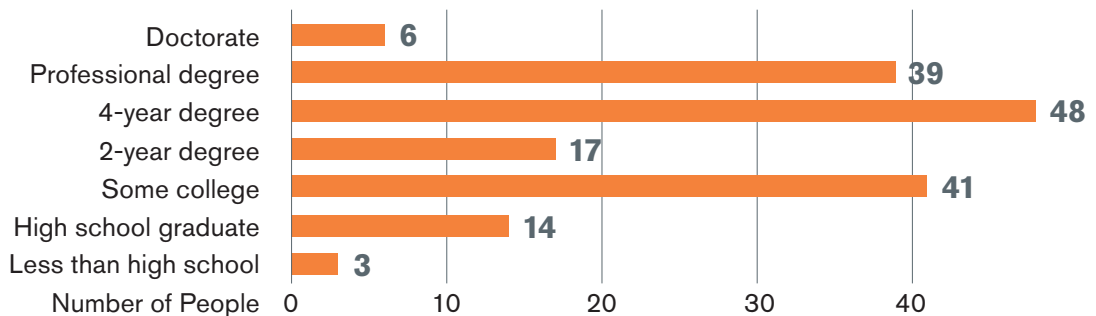


Figure 15 "What is the highest level of education you have obtained?"

The majority of respondents indicated they were at least moderately familiar with the terms “community forest” and “ecosystem services” at the time of the survey. Respondents were asked to evaluate which ecosystem services were the most important to them. The top 5 choices were clean water, improved wellbeing, outdoor recreation space, less noise, and wildlife habitat. These choices were only slightly favored over the rest, with all categories being heavily ranked as ‘important’ (Figure 16). These results indicate that respondents would likely support a CFP that provides for more park space and green infrastructure. The addition of more trees can help Peoria increase the provision of these highly valued ecosystem services.

The following question asked respondents to assess how well Peoria’s community forest currently provides these same services (Figure 17). These responses demonstrate that residents see room for improvement for the community forest. A good sign from the survey responses is that residents are provided some level of access to these services.

Residents were then asked to identify how severe certain problems were in their experience with the current community forest. The two most common problems were “places for litter to accumulate” and “plants that cause allergies”. Close behind were “leaf litter/fruit drop” and “personal tree care expenses.” Figure 18 lists the full results for this question.

Surprisingly, one of the problems recognized as severe was lack of public funding for tree care. While it cannot be truly determined from the wording of the question, this lack of funding may have been noticed in lack of proper maintenance or lack of trees altogether. Most respondents felt that common tree-related issues like sidewalks broken by tree roots and wildlife accumulation were not issues at all.

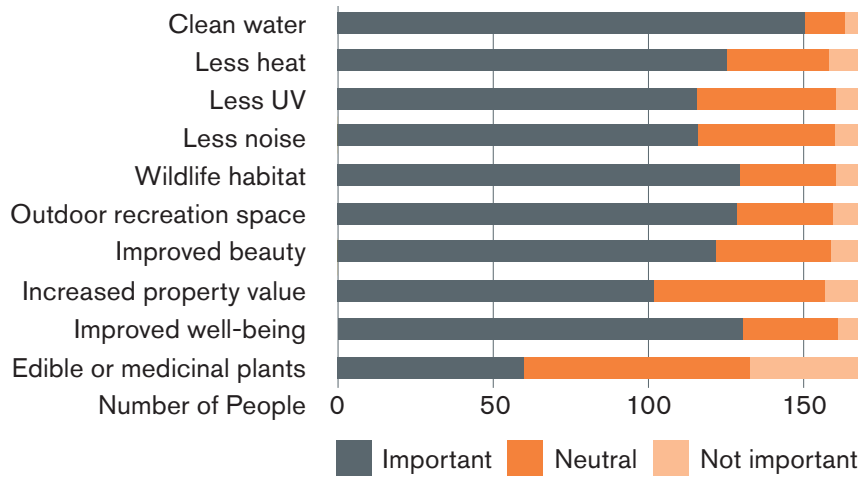


Figure 16 "Rate the various ecosystem services by importance"

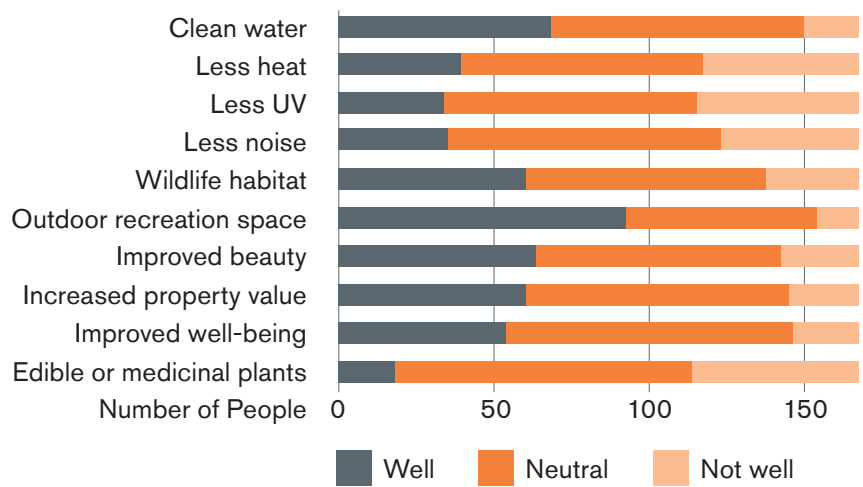


Figure 17 "How well do you think Peoria's community forests currently provide the following ecosystem services?"

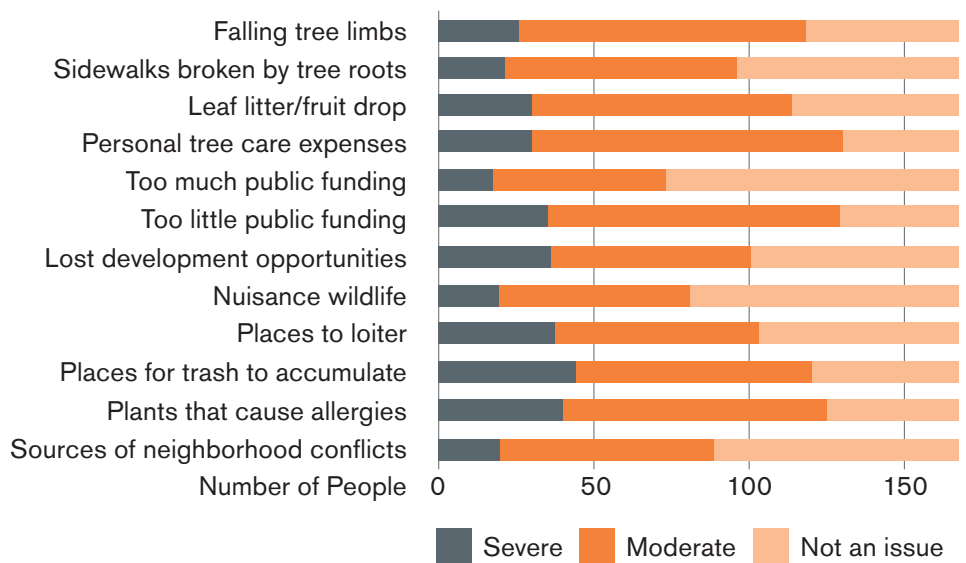


Figure 18 "How severe of a problem do you think the following community forest issues are in Peoria currently?"

Next, residents were asked to identify what they consider to be the most severe threats to the community forest. The threats marked “most severe” by respondents included changes in climate, increasing city population, and habitat loss. It is likely that these were identified because residents consider the growth of the city to reduce community forest coverage. A successful CFP will remedy some of these concerns by incorporating trees into the fabric of urban design. It will be crucial for Peoria to take into consideration changes in temperature and precipitation when selecting trees to plant, as well as how sprawl may impact existing tree coverage and how a budget can be carefully maintained to preserve the integrity of the canopy. These results are viewable in Figure 19.

When asked about preferred goals for community forestry management, citizens considered sustainability, an improved sense of community, climate change mitigation, and heat reduction all important for defining a future CFP (Figure 20). This is promising and could mean that there is great potential for Peoria’s CFP if they were to link it with the existing sustainability plan and frame it as a project for bettering multiple aspects of society.

Respondents were also asked to indicate how well the following examples demonstrate successful community forestry management by the city (Figure 21). Tree maintenance, more park visitors, more trees, and more green space were shown to be strong metrics that are identifiable by residents. A general feeling of safety in public parks was also chosen as a measure of success.

The final survey question asked if respondents would support Peoria moving forward with the Community Forestry Program. There was a resounding level of support indicated, with 158 out of 169 people that answered the question saying yes. This is very promising and shows that there is support within the community for expanded community forestry. The survey proved to be a valuable method of collecting information from the residents of Peoria. While it may have been beneficial to see more responses to paint a more accurate picture of Peoria citizens’ perspectives, it is encouraging that there is a general feeling of support and a decent understanding of how community forestry could benefit the City.

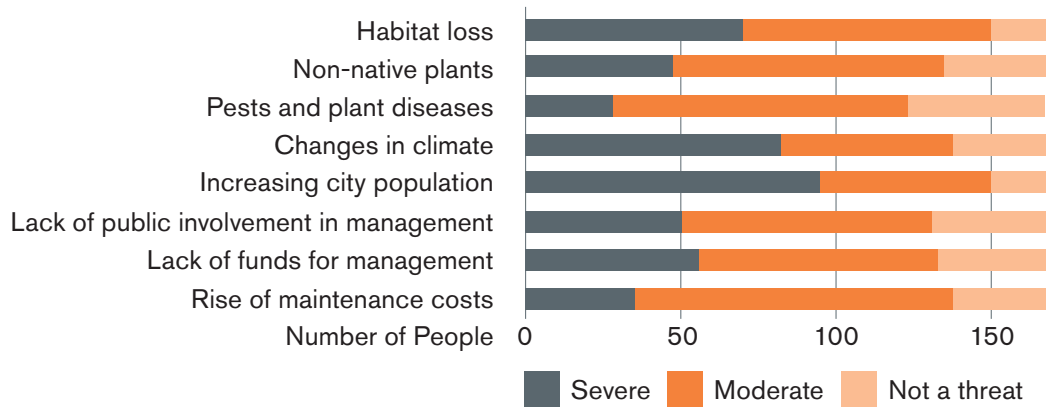


Figure 19 "How severe do you think the following threats are to community forestry in Peoria?"

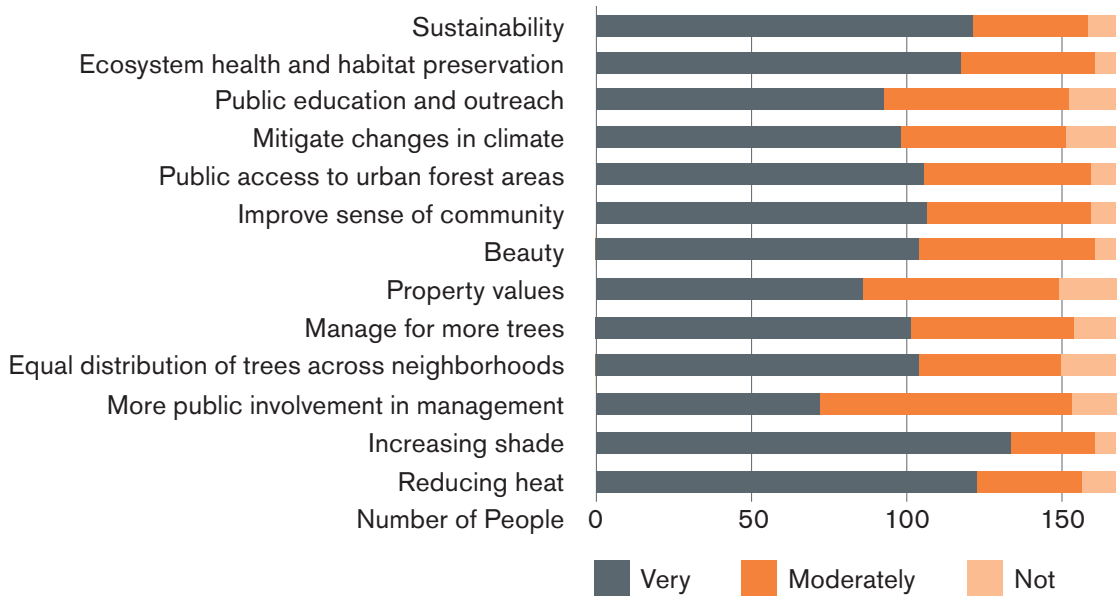


Figure 20 "How important do you think the following goals should be in defining the City of Peoria's community forest management plan?"

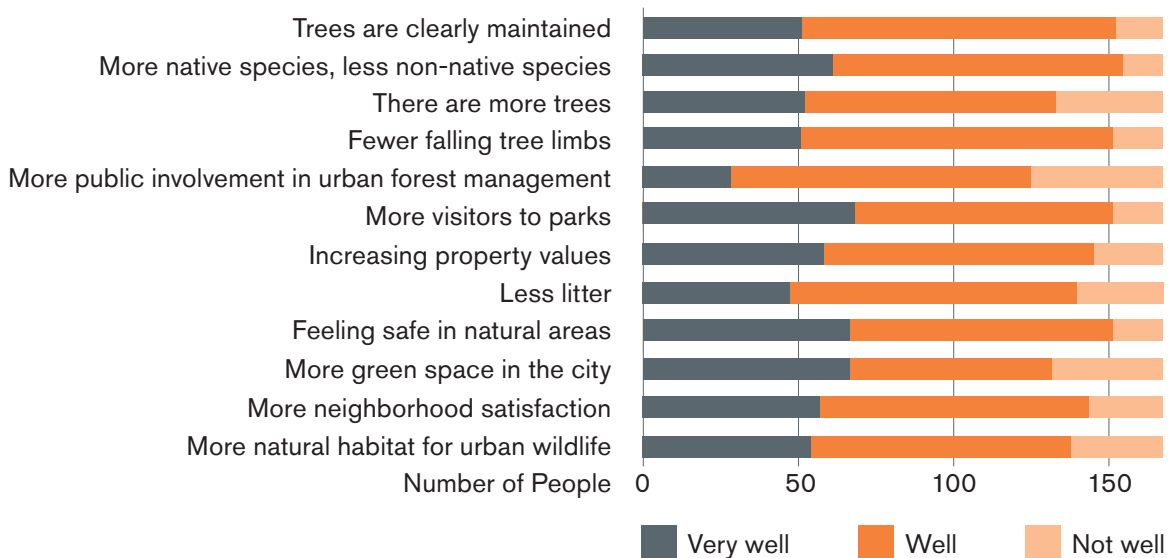


Figure 21 "How well do you think the following examples indicate successful community forestry management by the City of Peoria?"

Recommendations

Because of the positive response from the sustainability plan survey and community forestry survey, it is suggested that Peoria begin developing a forestry program that is equitable, responsible in regards to water usage and management, and outlines appropriate maintenance techniques for trees on municipal, commercial, and private properties. In order to increase citizen support for this undertaking, we advise to speak to the environmental, social, and economic advantages of increasing urban shade through a CFP. It is crucial to make it clear to citizens that existing trees will be maintained carefully; this maintenance would need to include climate-appropriate watering techniques, a level of trimming that will ensure canopies provide shade but do not interfere with citizen activities, and responsible and timely removal and replacement of trees that have been downed by storms.



Figure 22 Desert native Palo verde trees are one feasible option to incorporate in Peoria's community forestry plan

Prioritize education

By researching other forestry and shade plans, it was found that many of the documents were not heavily code-based; rather, they focused on education, budgeting, and implementation timelines. Forestry-based code is needed to ensure that no harm stemming from citizen malpractice or vandalism befalls the urban canopy, but is not a strong factor in development of CFPs. Most plans suggested that code changes will be crucial to make in the future, but education should be the initial priority.

Enhance Peoria 311 app

We recommend that the Peoria 311 app be made available on App stores (Apple, Android and Google) and have options available for citizens to report beyond downed trees. One possible feature to integrate community forestry into the app could be the ability for users to place a pin on a satellite map of the city where they would like additional shade. Concentrations of pins could help guide maintenance crews on areas where tree plantings are a priority.

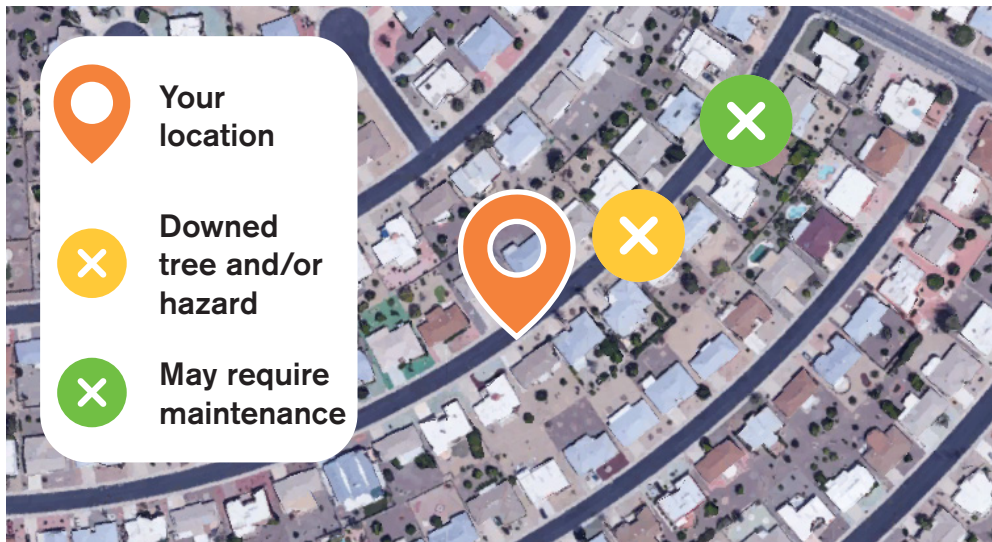


Figure 23 Mockup of potential Peoria 311 app community forestry feature

Create a forestry board

Peoria does not have a citizen tree planting or forestry board; creating a board to advise tree maintenance personnel and policy decision makers on forestry topics could help ensure community involvement and input in CFP development. If creation of an entire board is not feasible, then a subcommittee or designated “forestry board members” could be added to the existing Parks and Rec board to advise on urban trails and the intersection of shade and walkability.

Install fruit trees

Adding fruit-bearing trees to the public areas within the urban landscape provides benefits beyond shade provision. Advertising a citrus-lined walkway or corridor as a “food forest” could promote tourism and inspire discussions about sustainable and local food production. Additionally, whatever produce is not picked and consumed by passersby could be donated to local low-income housing centers or shelters.

Increase maintenance transparency

As hinted towards in the Sustainability 3.0 survey, there is a lack of public understanding of what tree maintenance staff do. Actions such as removing trees can be confusing to local homeowners or pedestrians if there is no explanation given as to why that tree was removed (e.g., if it was diseased or otherwise compromised). If Peoria tree maintenance staff were to do social media takeovers, run a blog, or have another method of creating transparency, the community would have a resource with which to become familiar with common city forestry practices.

Produce accessible educational content

Virtual or in-person classes for a variety of age groups discussing the benefits of trees is another tool that Peoria could utilize to broaden resident understanding of urban forestry, biodiversity, water conservation and sustainability. Holding these events for a low cost or free at community centers, or recording them as an educational video mini-series, can help increase access to the information.

Consider hiring forestry consultants or city staff

Although it may not be feasible at this time, Peoria could hire an urban forester to work for or consult for the city, similar to Richard Atkin's role in Tempe. While Peoria does have arborists that are working on the forestry plan, a dedicated individual whose primary focus is the development of the urban canopy would likely shorten creation and implementation time of a CFP as well as serve as a spokesperson for tree-related educational campaigns.

Overview

The responses in the survey showcase that there is a need for community education on the subject of community forestry, and a demand for an expanded tree canopy due to the ecological services it would provide. In summary, adding additional tree guidelines or restrictions in Peoria's code may not be the best way to spearhead change in a CFP (although code may have to be altered in the future based on the rate of greenfield development, or development on previously undeveloped open land). Rather, **education, maintenance visibility, and consistent citizen input are key to plan development, implementation, and success.** Because many forestry plans in local cities are relatively new, it is nearly impossible to guarantee success with one specific approach without the implementation of tests, such as pilot projects.

In general, the CFP should aim to increase tree canopy and publicly accessible green spaces around the city. Guidelines can be strengthened so a certain number of parks are accessible per development unit. It is recommended for all bus stops to have natural or artificial shade provision, and to be accessible by bike lanes. The City can use the survey results in this report as a guide to determine the greatest priorities of the CFP. Community support for this plan is promising, and it has the potential to change Peoria's urban form for the better, thereby increasing the well-being of residents and visitors.



Figure 24 Urban forestry can take many different forms, this corridor features both ornamental accent trees as well as functional shade trees

CONCLUSION

Based on the research conducted during the course of this culminating project, developing a community forestry program appears to be a feasible action for the City of Peoria. When implemented, increased urban forestry has the potential to benefit Peoria businesses, residents, and visitors through energy savings, pedestrian safety, and community identity. This project could also benefit from being continued and expanded upon by future students. For example, a reasonable next step could involve conducting pilot programs in strategic locations within Peoria where there is heavy pedestrian traffic. Higher traffic may yield more data around the overall impressions and reception of the increased vegetation. Another continuation of the project could involve working with the Peoria planning department to further guide the drafting of a Community Forestry Program plan document.

Not all aspects of the scope provided by Peoria came to fruition in this project as a result of COVID-19 related complications (such as the inability to speak face-to-face with Peoria citizens), IRB delays, and only having a few short months to create content-rich deliverables for the City. Students were unable to work with the city to analyze budget constraints and reduce inefficiencies in current tree maintenance, as well as identify a forestry focus group or local business/nonprofit/municipality partnerships. Despite setbacks, the deliverables that were able to be provided for Peoria will undoubtedly assist them in creating an efficient and sustainable CFP.

Implementing an urban forestry program in Peoria is another step toward the equitable distribution of shade and heat mitigation in communities affected by rising temperatures and the Urban Heat Island effect. Building a Community Forestry Program could also provide an example for other arid cities and towns to follow, further increasing the sustainability impact of Peoria's efforts. In addition to the quantifiable benefits of increased shade and vegetation, urban forestry can provide residents with a greater connection to nature, and increase the collective happiness of Peoria's citizens.

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