Oklahoma City Metropolitan Area

Tree Canopy Assessment

2019



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DAVEY Resource Group

Oklahoma City Metropolitan Area

Tree Canopy Assessment

2019

Prepared for:

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Acknowledgements:

This report is adapted from the standard i-Tree Ecosystem Analysis report that is generated upon submission of i-Tree Eco data. i-Tree Eco (formerly Urban Forest Effects model) was cooperatively developed by the USDA Forest Service Northeastern Research Station (NRS), USDA State and Private Forestry's Urban and Community Forestry Program and Northeastern Area, Davey Tree Expert Company, and SUNY College of Environmental Science and Forestry.

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Executive Summary

The Oklahoma City Metropolitan Area Study Area sits within the Cross Timbers forest which is located where the eastern forest meets the upland Prairie grasslands. This forest cover type spreads across most of Oklahoma City Metropolitan Area continuing into Kansas and Texas.

This Tree Canopy Assessment is the first of its kind conducted within a 536 square mile study area in this part of the state. This assessment was conducted during the spring and summer of 2019. This area includes portions of or all boundaries within the communities of Oklahoma City, City of Edmond, City of Bethany, City of Moore, City of Mustang, Midwest City, City of Yukon, Lake Aluma, Town of Forest Park, Del City, City of Spencer, The Village, Nichols Hills, City of Warr Acres, Valley Brook, City of Norman, Woodlawn Park, Smith Village, and Tinker Air Force Base.

Understanding the location, makeup and extent of the forest canopy contained in this area is key to developing and implementing sound management strategies that promote the sustainability and growth of the study area's forest resource and the benefits it provides.

This comprehensive assessment identifies and quantifies the area's land cover, structure and numerous environmental benefits, which include energy savings, air and water quality improvements, stormwater interception, quality of living, human benefits and other socioeconomic benefits. Trees also provide additional aesthetics and beautification back to neighborhoods and the community at large.

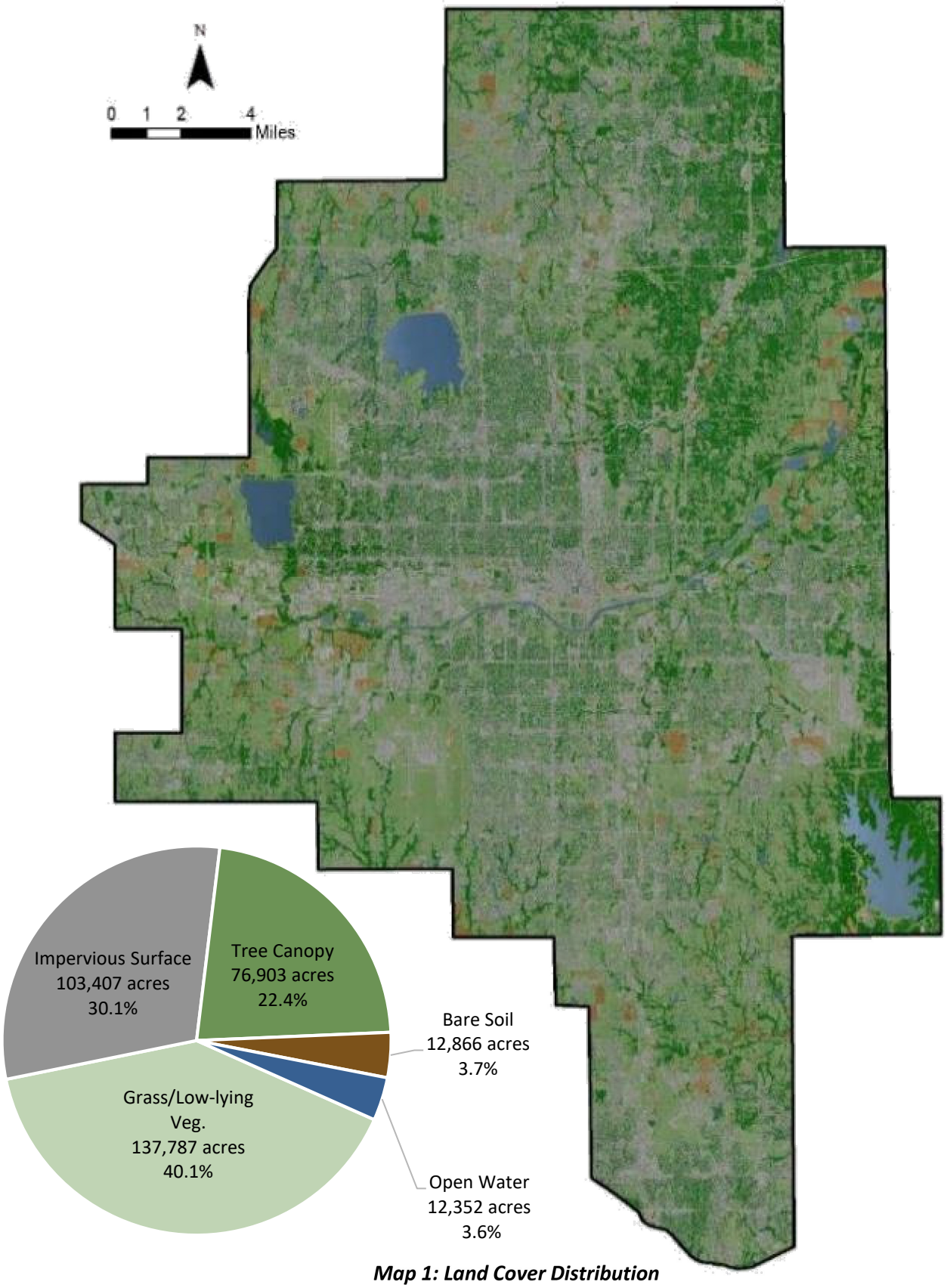
In recognition of this valuable resource, Oklahoma City Community Foundation (OCCF) in partnership with the Association of Central Oklahoma Governments (ACOG) and Oklahoma Forestry Services contracted with Davey Resource Group Inc. (DRG) to conduct this assessment.

Part of the assessment included using high resolution satellite imagery to provide a birds-eye view of the entire forest within the study area showing the land cover type and distribution of existing tree canopy and its relationship to the developed areas in Oklahoma City Metropolitan Area. Along with the land cover assessment, a planting priority analysis was conducted to provide guidance and recommendations for future plantings to help mitigate the impacts of urban heat islands, improve human health benefits, help mitigate stormwater runoff and provide other valuable environmental and aesthetic benefits.

To better understand the structure, composition and value of the benefits provided from the trees vegetation and forest, a sample inventory of public and private trees combined with the i-Tree *Eco* modeling formula was conducted. Through this analysis, it was determined that the study area has an estimated 65 million (SE[1] 10 million) trees annually providing as much as $150 million dollars in environmental benefits within this study area.

In addition to this assessment, a review of select ordinances impacting tree planting was conducted for the City of Oklahoma City. Ordinances were reviewed to determine the strengths and weakness in utilizing trees to help address environmental and aesthetics benefits and services. Resulting recommendations can be used as resources for providing guidance for pro-active planning, implementation and maintenance objectives communities might be considering.

[1] SE or standard error is a measure of the statistical accuracy of an estimate (Appendix B)



Map 1: Land Cover Distribution

Table 1: Benchmark Values for the Study Area's Urban Forest Resource

Land Cover (2016)	
Overall Canopy Cover	22.40%
Impervious Surfaces	30.10%
i-Tree *Eco* (2019)	
Estimated total number of trees	64.7 million (SE 10 million)
Urban Forest Benefits (2019)	
Annual Carbon Sequestered	$35 million
Annual Pollution Removal	$77.7 million
Annual Energy Benefits	$14.2 million
Annual Avoided Runoff	$22.7 million
Species Diversity (2019)	
Estimated Total Number of Unique Species	74
Prevalence of Top Five Species	47.90%
Species Exceeding Recommended 10%	1
Carbon Stored (2019)	4.8 million tons

Urban Forest Resource Summary

Landcover

The Tree Canopy Assessment encompasses 536.4 square miles (343,314 acres). Excluding impervious surface (103,407 acres) and open water (12,866 acres), this area contains approximately 197 square miles (125,832 acres) which has the potential to support tree canopy. The following information characterizes land cover within the study area (Map 1):

- 76,903 acres (22.4%) of tree canopy, including trees and shrubs
- 137,787 acres (40.1%) of grass and low-lying vegetation
- 103,407 acres (30.1%) of impervious surface, including roads and structures
- 12,866 acres (3.7%) of bare soil
- 12,352 acres (3.6%) of water
- A maximum tree canopy potential of 59.1%

Structure

A sample inventory of 300 randomly selected 1/10 acre plots conducted on public and private lands was used with the i-Tree Ecosystem services modeling application. Through this analysis, it was determined that the study area has an estimated 65 million (SE 10 million) trees.

A total of 2,237 trees were measured on the 300 plots. The following information characterizes the structure of the study area:

- Nearly 65 million total trees (SE 10 million trees)
- 74 tree species

- Eastern redcedar (*Juniperus virginiana*, 13.2%), slippery elm (*Ulmus rubra*, 9.7%), and western soapberry (*Sapindus saponaria ssp. drummondii*, 9.6%) are the most prevalent species
- 75% of trees are estimated to be less than 12 inches in diameter (DBH). Less than 1% of trees exceeding 24 inches in diameter (DBH)
- 4.8 million (SE 569,355) tons of carbon stored to date

Benefits

Annually, the study area's forest provides nearly $150 million in environmental benefits to the community. These benefits include (Figure 1):

- Reducing electricity (152,809 MwH) and natural gas (262,157 MBtu), valued at $14.2 million
- Intercepting nearly 340 million cubic feet of stormwater, valued at $22.7 million
- Removing 5,223 tons of air pollutants (CO, NO_2, O_3, $PM_{2.5}$, and SO_2) valued at $77.7 million
- Reducing atmospheric CO_2 by 205,160 (SE 20,864) tons, valued at $35 million

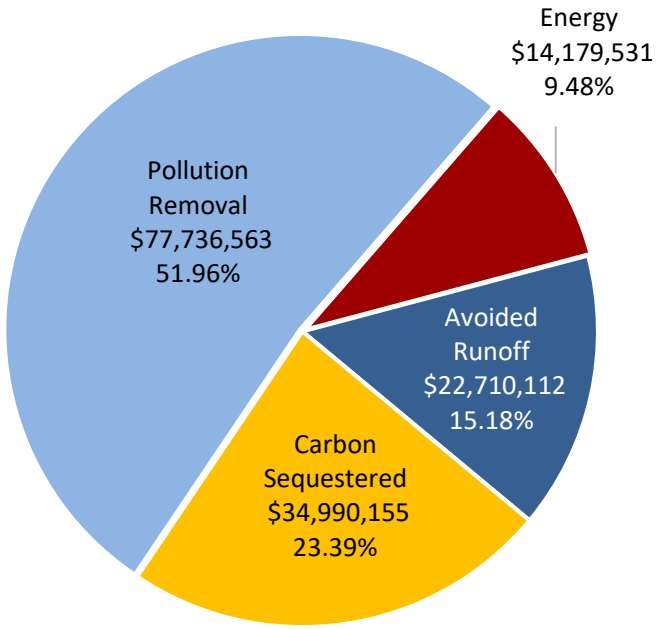


Figure 1: Annual Environmental Benefits of the Study Area's Urban Forest Resource

The study area's urban forest has beneficial effects on the environment, and annually contributes to nearly $150 million in benefits to the community. Table 2 summarize the annual benefits estimated by the i-Tree *Eco* assessment.

Table 2: Benefits of the Oklahoma City Metropolitan Area Study Area's Urban Forest Resource

Benefits	Total $	$/tree	$/capita
Energy	14,179,531	0.22	22.03
Gross Carbon Sequestration	34,990,155	0.54	54.36
Pollution Removal	77,736,563	1.20	120.77
Avoided Runoff	22,710,112	0.35	35.28
Total Benefits	**$149,616,362**	**$2.31**	**$232.45**

Composition and Diversity

Trees collected within the sample plots included 74 different tree species (Appendix C). The assessment estimates that the top 10 most common species represent nearly 75% of the overall urban forest population (Figure 2). The most prevalent species are eastern redcedar (*Juniperus virginiana*, 13.2%), slippery elm (*Ulmus rubra*, 9.7%), and western soapberry (*Sapindus saponaria ssp. drummondii,* 9.6%).

Maintaining diversity in a public tree resource is important. Dominance of any single species or genus can have detrimental consequences in the event of storms, drought, disease, pests, or other stressors that can severely affect a public tree resource. Catastrophic pests and pathogens, such as Dutch elm disease (*Ophiostoma ulmi*), Asian longhorned beetle (*Anoplophora glabripennis*), and sudden oak death (*Phytophthora ramorum*) are some examples of unexpected, devastating, and costly introduced species that highlight the importance of diversity and the balanced distribution of urban tree species and genera.

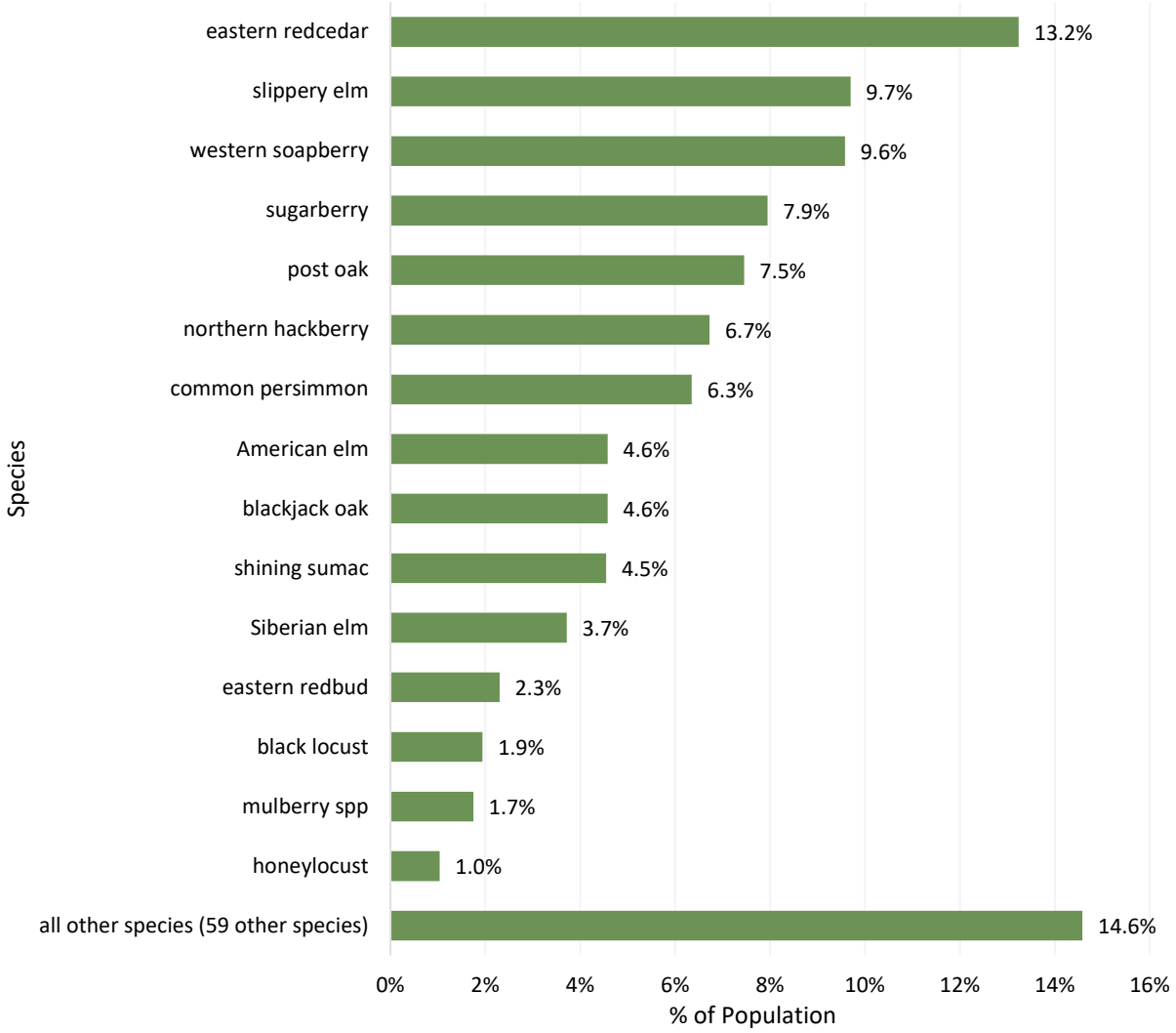


Figure 2: Species Diversity

Tree Condition

Tree condition is an indication of how well trees are managed and how well they are performing in each site-specific environment (e.g., street, median, parking lot, etc.). Condition ratings can help managers anticipate maintenance and funding needs. In addition, tree condition is an important factor in the calculation of public tree resource benefits. A condition rating of good assumes that a tree has no major structural problems, no significant mechanical damage, minor aesthetic, insect, or disease problems, and is in good health. When trees are performing at their peak, as those rated as good or better, the benefits they provide are maximized. This assessment provided condition ratings for trees in the study area (Figure 3).

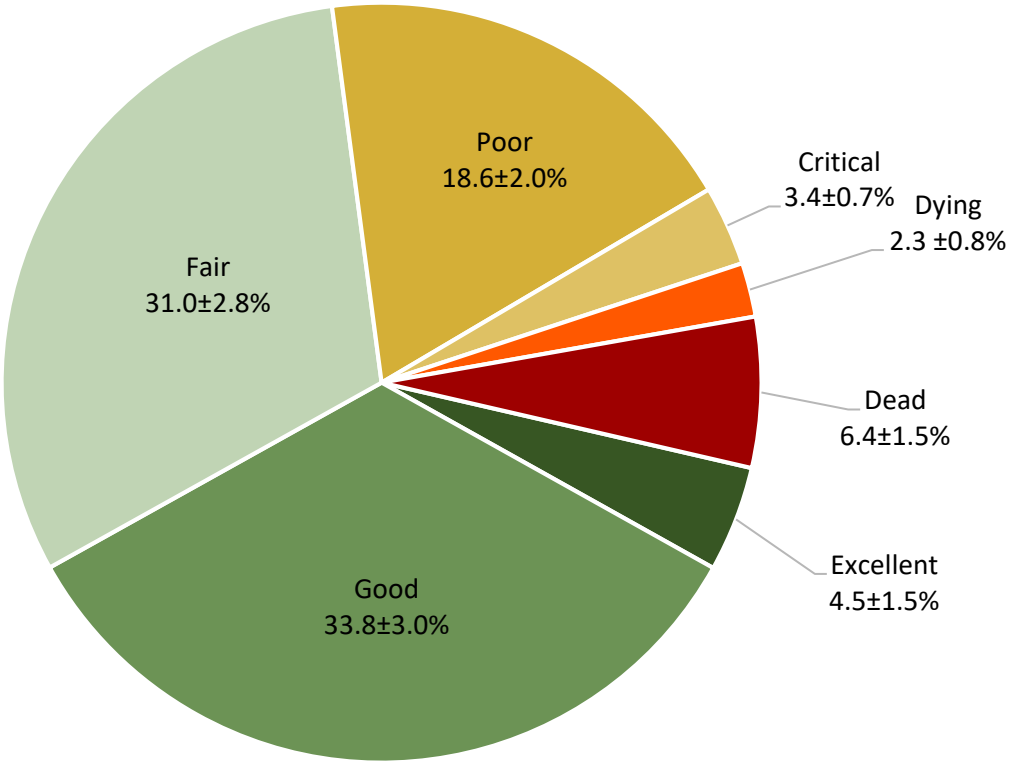


Figure 3: Tree Condition

Management Applications

Oklahoma City Metropolitan Area Study Area's urban forest resource is a dynamic resource that requires continued investment to maintain and realize its full benefit potential. Trees are one of the few community assets that have the potential to increase in value with time and proper management.

Characterizing the tree canopy and using this information to support management goals such as age, structure, species diversity, and locations of priority planting is important for the sustainability of the Oklahoma City Metropolitan Area Study Area's urban forest resource. The canopy data, combined with existing and emerging research, enables managers to balance urban growth with tree preservation and aids in identifying and assessing urban forestry opportunities. A spatial understanding of tree canopy helps urban forest managers and city leadership align urban forestry objectives with community vision. Identifying priority planting areas that yield the most return on investment is especially important.

The study area has an existing tree canopy cover of 22.4% and a maximum potential for 59.1% canopy. To help identify the most beneficial sites for expanding canopy, potential sites were mapped and then prioritized based on soils, slope, and existing canopy. These maps are valuable tools for guiding tree planting projects.

Appropriate tree species selection, site consideration, planting installation and timely short- and long-term tree care can substantially increase lifespan. When trees live longer, they provide greater benefits. As individual trees continue to mature and aging trees are replaced, the overall value of the community forest and the amount of benefits provided grow as well. This vital, living resource is, however, vulnerable to a host of stressors and requires ecologically sound and sustainable best management practices to ensure a continued flow of benefits for future generations.

Based on the i-Tree *Eco* assessment, the urban forest in the study area is a young resource in fair to good condition (see Appendix C for methodology). With an estimated more than 65 million trees (SE 10 million), proactive management, planning, and new and replacement tree planting are all critical for sustaining the benefits from this resource.

Based on the land cover and i-Tree *Eco* assessments, DRG recommends the following:

- Promote species diversity for greater resilience and pest resistance.
- Ensure that new tree plantings include a variety of suitable species and prevent an unduly increased reliance on prevalent species for greater resilience and pest resistance.
- Consider incorporating more species with Relative Performance Index (RPI) values of 1.0 or higher.
- Explore the use of species that have been successful in other parts of Oklahoma, including:
    - Shumard oak (*Quercus shumardii*)
    - bald cypress (*Taxodium distichum*)
    - pond cypress (*Taxodium ascendens*)

    - chinkapin oak (*Quercus muehlenbergii*)
    - Freeman maple (*Acer freemanii*)
    - trident maple (*Acer buergerianum*)
    - cedar elm (*Ulmus crassifolia*)
    - Arizona cypress (*Cupressus arizonica*)
    - Buckley oak (*Quercus buckleyi*)
    - escarpment live oak (*Quercus fusiformis*)
- Support the longevity of existing trees to preserve and increase benefits and to preserve a stable benefit stream.
- Use planting priority maps to strategically focus planting to increase trees and canopy that will support stormwater management, preserve soil, reduce urban heat islands, and complement the existing urban infrastructure for the greatest impact and return on investment.
- Strive for a more balanced and equitable urban forest by targeting low-income areas for planting priority.
- Prioritize planting trees in parks. The study area's 313 parks and open spaces have 2,163 acres that have the potential to support additional tree plantings.
- As land use zones designated for planned uses are developed, preserve existing tree canopy as much as possible.
- Consider adopting and/or revising guidelines and ordinances that enhance opportunities to utilize trees in addressing, public health, aiding in stormwater management and address other vital environmental issues.
- Whenever feasible, incorporate trees into trails and pedestrian thoroughfares in communities within the study area. Increased canopy cover can encourage cycling and pedestrian foot-traffic which translates to positive indicators for public health and reduced demand for other modes of transportation.
- Use tree plantings in watershed floodways with lower canopy cover to mitigate "peak flows" for future flood events.
- Consider incentives for tree planting on private property, particularly in high and very high priority planting areas and in neighborhood associations with lower tree canopy cover.

With adequate protection and planning, the value of the urban forest resource in the study area will increase over time. Proactive management and an ongoing tree replacement plans are critical. Along with new tree installation and replacement planting, funding for tree maintenance and inspection is vital to preserving benefits, prolonging tree life, and managing risk. Existing healthy mature trees should be maintained and protected whenever possible since the greatest benefits accrue from the continued growth and longevity of existing canopy. All citizens can take pride in knowing that the study area's trees help support the quality of life, improve community well-being and contribute to improved human health for all residents across the entire region.

Tree Canopy and Geographic Information Systems

Tree Canopy is the layer of leaves, branches, and stems that cover the ground when viewed from above. Trees provide benefits to the community that extend beyond property lines, therefore the land cover assessment includes all tree canopy within the borders of the community and does not distinguish between publicly-owned and privately-owned trees. To place tree canopy in context and better understand its relationship within the community, the assessment contains other primary landcover classifications, including impervious surfaces, pervious surfaces, bare soils, and water.

As more communities focus attention on environmental sustainability, community forest management has become increasingly dependent on geographic information systems (GIS). GIS is a powerful tool for urban tree canopy mapping and analysis. Understanding the extent and location of the existing canopy is integral to identifying various types of community forest management opportunities, including:

- Future planting plans
- Stormwater management
- Water resource and quality management
- Impact and management of invasive species
- Preservation of environmental benefits
- Outreach and education

High-resolution aerial imagery (2016) and infrared technology remotely map tree canopy and land cover (Figure 4). The results of this assessment provide a clear picture of the extent and distribution of tree canopy within study area. The data developed during this assessment will become an important part of the GIS database for the region and will provide a foundation for developing community goals and urban forest policies. With this data, managers can determine:

- Study area's progress towards local and regional canopy goals
- Changes in tree canopy over time and in relation to growth and development
- The location and extent of canopy at virtually any level, including land use, zoning, and parks
- The location of available planting space to develop strategies for increased canopy in underserved areas

In addition to quantifying existing urban tree canopy, this assessment illustrates the potential for increasing tree canopy across the study area. The data, combined with existing and emerging urban forestry research and applications, can provide additional guidance for determining a balance between growth and preservation and aid in identifying and assessing urban forestry opportunities.

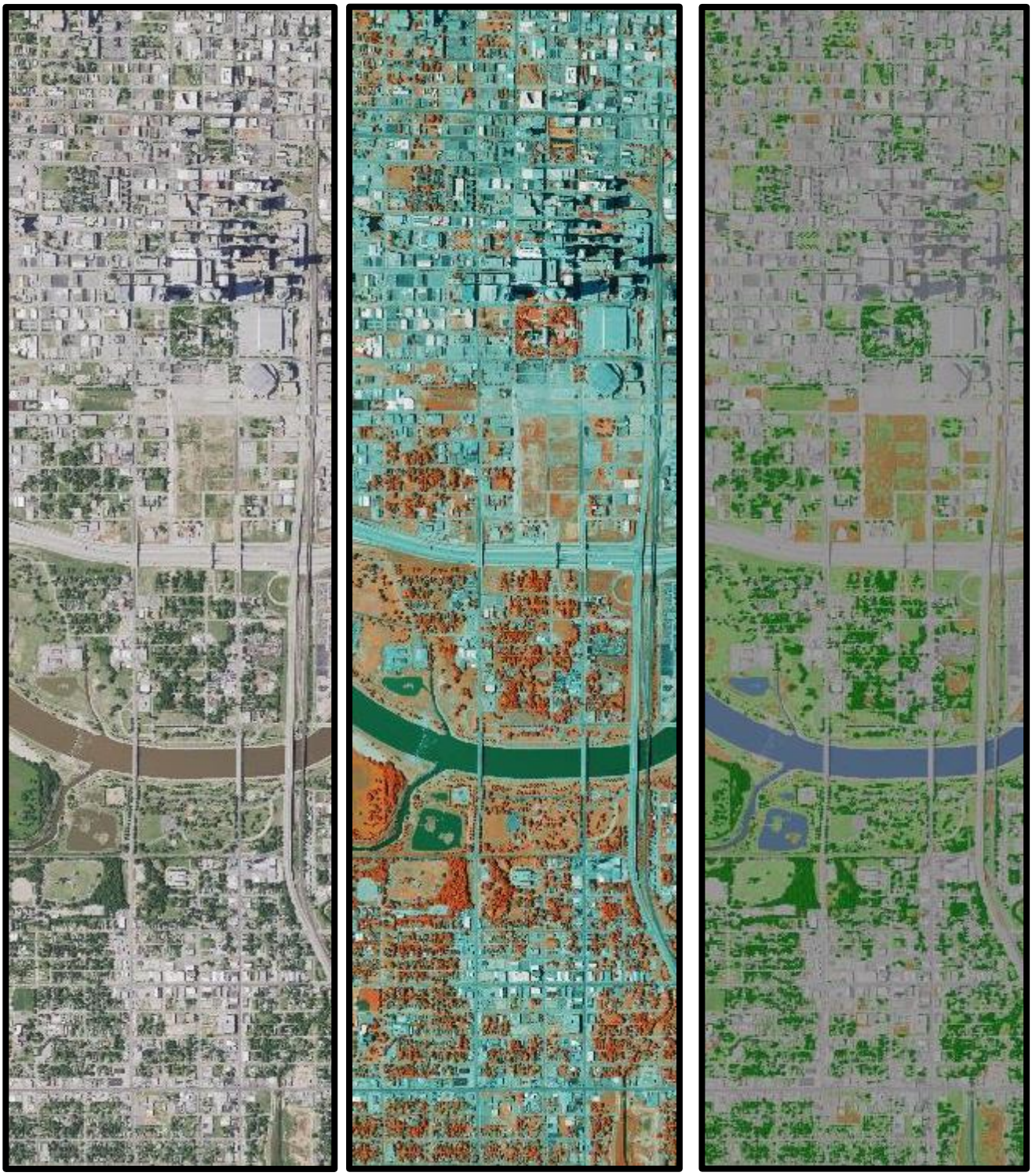


Figure 4: Land Cover Mapping

High-resolution aerial imagery (left) is used to remotely identify existing land cover. Infrared technology delineates living vegetation including tree canopy (middle). Remote sensing software identifies and maps tree canopy and other land cover (right).