PLAN-IT GEO LLC

AN ASSESSMENT OF URBAN TREE CANOPY IN JACKSON, MISSISSIPPI

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Urban Tree Canopy in Jackson, Mississippi

September 2013

Prepared By

plan-it GEO

Acknowledgements

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Core partners included the Mississippi Forestry Commission, Urban Forestry South, City of Jackson, City of Olive Branch Parks & Recreation, City of Horn Lake Public Works, and the City of Southaven. In addition, thanks go to Jerriot Smash, Todd Matthews and Jim Hancock for their invaluable assistance at many stages of this project.

Prepared For

Mississippi Forestry Commission
Urban Forestry South
The City of Jackson

An Urban Tree Canopy study is needed to inform management and planning initiatives for urban forests. Complete and sustainable urban forestry programs involve a shared vision for the desired quality of life and level of service that tree canopy can provide the urban environment and its inhabitants.

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JACKSON, MISSISSIPPI

URBAN TREE CANOPY ASSESSMENT 2013

EXECUTIVE SUMMARY

The City of Jackson's urban forest is comprised of trees, gardens, green spaces and other natural areas. This urban forest provides numerous benefits by making environments cleaner, safer, and more livable, therefore contributing directly to public health and reducing the costs associated with many required services.

To manage, monitor and enhance the quality and stream of benefits received from its urban forests, the Mississippi Forestry Commission and the City of Jackson have initiated this study to assess the extent of Urban Tree Canopy (UTC) across the city. This report presents results for current land cover and UTC distribution and offers data analysis, custom maps and tools, and recommendations for setting and achieving UTC goals.

URBAN FOREST ASSESSMENT APPROACH

Natural resource managers use top-down (aerial imagery) and bottom-up (field-based) approaches to measure land cover, trees and other green infrastructure, and associated ecosystem services. Terms and methods for UTC assessment are presented in this report. Additionally, steps used to identify potential planting sites are described and explained. See project Fundamentals section on page 7.

URBAN TREE CANOPY IN JACKSON

This study encompasses 72,678 acres (114 square miles) defined by the city limits of the City of Jackson, Mississippi. Based on a land area (after excluding water) of 71,078 acres, the City has 35,962 acres (51%) of existing tree canopy, 29,629 (23%) of Vegetated Possible Planting Area, or PPA Vegetation, which is defined as non-canopy vegetation where tree planting is possible. Additionally, 3,388 acres (5%) of Jackson is likely unsuitable for tree planting (i.e. water bodies, roads). The land cover data was

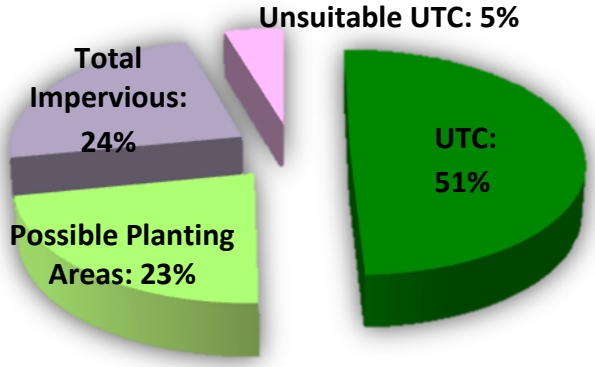
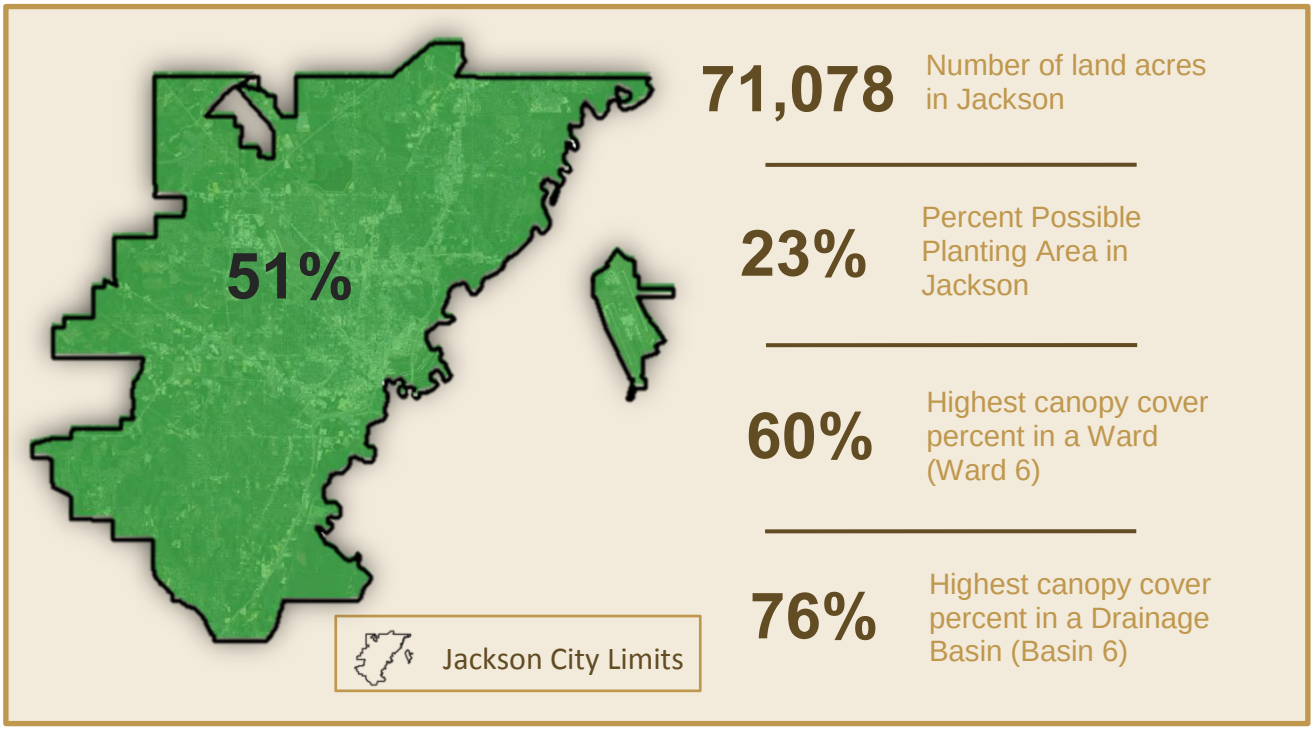


Figure 1: Distribution of UTC Metrics in Jackson

used to assess similar metrics for the City's wards, drainage basins, census blocks, and parcels. See Results section on pages 12-19.

Tree Canopy and Sustainability

Sustainability planning requires balancing economic progress with a community's social capitol and environmental resources for future generations. Urban forests are one of many assets that contribute to a resilient, sustainable Jackson. The results of this assessment are presented by three key aspects of Jackson's sustainability framework; Policy & Planning, Energy Conservation, and Stormwater Management. See Assessment Results and Products description on page 12.



Recommendations and Summary

Understanding how and where trees are concentrated and distributed across the City of Jackson is essential for maintaining a healthy and sustainable urban forest. This study provides the most up-to-date analysis to foster this overarching goal.

The City of Jackson maintains an impressive 51% tree canopy cover. Areas at-risk of forest loss from development and natural processes must be protected for the urban forest to continue contributing to quality of life, energy efficiency, and stormwater management. In order for an effective urban forest plan, city officials must value the urban forest in environmental, social, and economic terms during various planning processes. Enhancing green infrastructure depends on strategic canopy increases, ongoing care and maintenance, and education on the benefits of UTC. This ensures that trees appreciate over time and that their contributions toward addressing issues and improving community health are maximized. Ultimately, this study provides hard data for planning and decision-making. See Recommendations and Summary on sections on pages 20-22.

PROJECT BACKGROUND

The Capital City of Jackson is located in Central Mississippi, covers approximately 114 square miles, and has a population of 175,561 (2011 census). The project background introduces:

- The funding sources and partners
- The key data analyzed for the assessment and how the information is used
- The benefits of managing, protecting and enhancing this resource

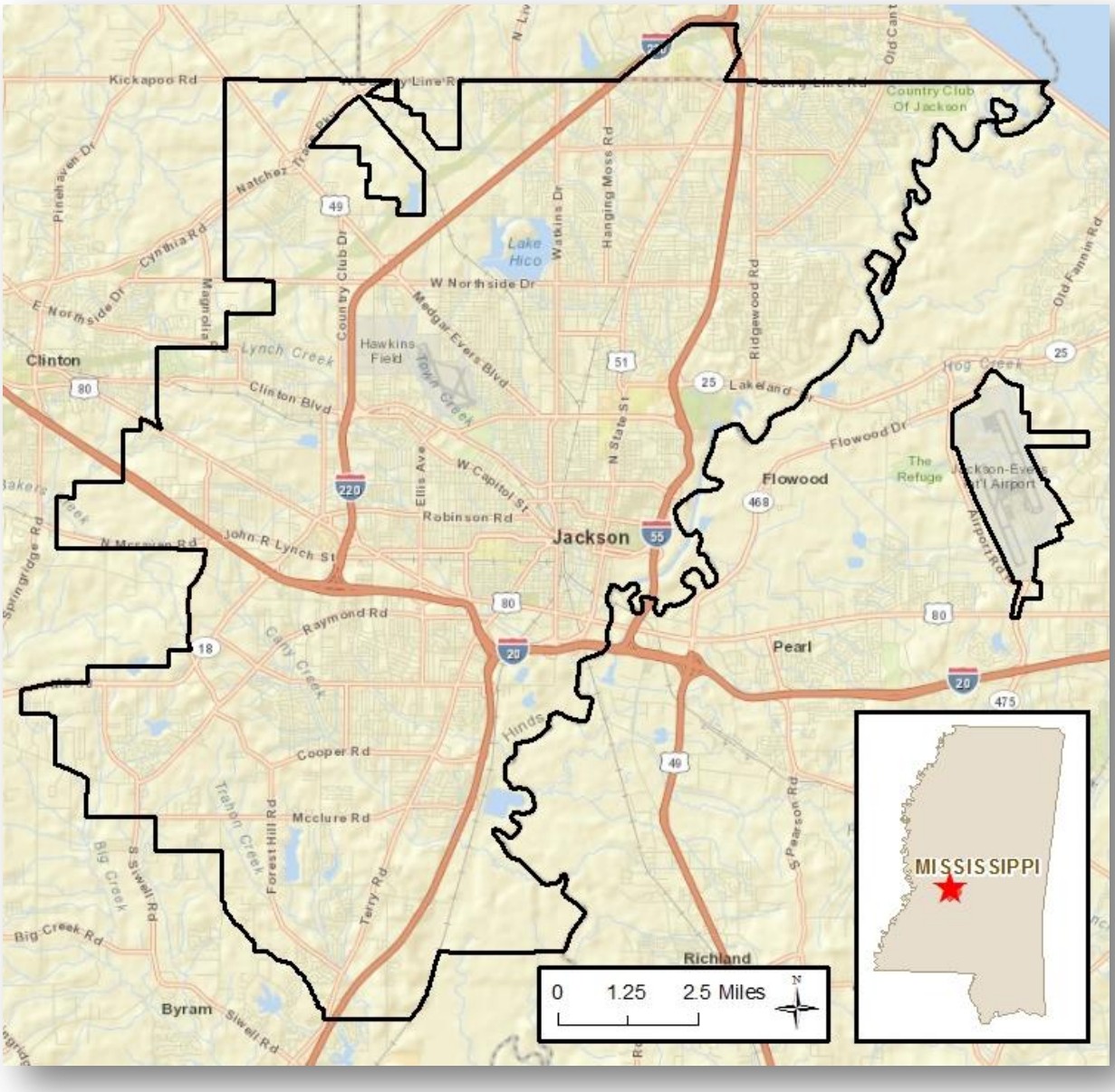


Figure 2: Jackson, Mississippi city boundary mapped in this report.

Funded by the US Forest Service, the Mississippi Forestry Commission contracted Plan-It Geo to conduct Jackson's Urban Tree Canopy Assessment. As part of the *Canopy in the Mid-South* grant, comprised of 16 cities throughout Mississippi, Arkansas, and Tennessee, this project included assessments in Jackson, as well as Horn Lake, Southaven, and Olive Branch, MS. The information measures existing canopy cover, strengthens local/state partnerships, builds awareness of urban forest benefits, provides a baseline of information for increasing environmental services, and allows Jackson and State of Mississippi to establish canopy goals and strategies.

Using geographic information systems (GIS) and remote sensing technologies, land cover classes mapped and assessed for Jackson include:

Urban Tree Canopy: Tree cover, when viewed and mapped from above

Vegetation: Irrigated and non-irrigated vegetation

Impervious: Surfaces: roads, buildings, sidewalks, parking areas and other impervious surfaces

Soil: Dry vegetation/ bare soil

Water: All water bodies, including lakes, rivers, and streams

The land cover data is used to examine the area and percent cover for existing tree canopy, possible planting areas for enhancing canopy in strategic areas, and areas unsuitable for planting. At a finer scale in the City of Jackson, these metrics were calculated for the following assessment boundaries: (1) 2010 Census Blocks, (2) 2010 Wards, (3) Parcels, and (5) Drainage Basins (see Table 1 on page 10).

What the UTC Assessment provides:

This project provides maps and statistical quantification of existing urban tree canopy, possible planting areas and other land cover classes across the City of Jackson, and targeted areas where tree planting and preservation can benefit the City the most.

Why the UTC Assessment is necessary:

This assessment provides an up-to-date benchmark of urban forest canopy cover, a critical component for effective urban forest management planning.

How Jackson will use this UTC Assessment:

The tools and information resulting from this analysis should be used by community members, planners, and managers to understand and improve forest management across the City. Additionally, the information provided can help the Public Works department utilize the City's urban forest to support Jackson's '*Green Initiatives'* (see page 11 for more information).

MAJOR FINDINGS

LAND COVER IN JACKSON, MISSISSIPPI:

- Jackson has 51% (35,962 acres) urban tree canopy and 23% (16,342 acres) of additional area available for tree planting.
- 24% (16,986 acres) of Jackson is covered by impervious surfaces.

CANOPY BY WARDS:

- Of Jackson's 7 Wards, Ward 6 has the highest UTC at 60% (5,139 acres), while Ward 3 has the lowest at 36% (2,022 acres).
- Ward 3 has the highest possible planting area (PPA Vegetation) at 26% (1,458 acres), although Ward 2 has the highest acreage of PPA Vegetation 3,433 acres (25%).
- Ward 7 has the most area by acres of PPA Vegetation (3,705 acres) and the highest amount of impervious area (4,561 acres).

CANOPY BY DRAINAGE BASINS:

- Of Jackson's 17 Drainage Basins, Basin 6 has the highest UTC at 76% (532 acres), while Basin 9 (Town Creek) has the lowest at 30% (2,685 acres).
- Basin 9 (Town Creek) has nearly 40% (3,556 acres) impervious surface cover with 26% (2,336 acres) of grassy vegetation.

CANOPY BY CENSUS BLOCKS:

- The 2010 Census Data maps 4,543 census blocks in Jackson. 724 of these blocks have less than 20% tree canopy, but greater than 15% planting area, and could be targeted for expanding tree cover.

PROJECT FUNDAMENTALS

How Are UTC Results Used?

- To set and implement canopy cover goals
- To prioritize areas for tree planting and preservation
- To analyze and visualize tree planting opportunities
- To work with multiple, diverse partners to achieve and maintain goals

This section describes:

- ✓ Mapping Land Cover & Urban Tree Canopy
- ✓ Urban Forest Ecosystem Benefits
- ✓ UTC Terminology
- ✓ Assessment Boundaries
- ✓ Green Initiatives within Jackson

The "top-down" UTC assessment conducted for Jackson provides an accurate evaluation of canopy cover within the desired boundary. The following section describes the data and methods used for land cover classification, the terminology for defining and assessing Urban Tree Canopy (UTC) and Possible Planting Areas (PPA), and the boundaries (geographic units of scale) that were assessed.

MAPPING LAND COVER AND URBAN TREE CANOPY

Aerial photography (2012 National Agricultural Imagery Program) at 1-meter pixel resolution was used as the basis for this UTC assessment. Object-based image classification results were combined with GIS data provided by the City to produce a five (5) class land cover layer. Numerous GIS layers from the city, county and state were used to map the following five land cover classes in Jackson: (1) tree canopy, (2) other low-lying vegetation, (3) impervious surfaces, (4) bare soil/dry vegetation, and (5) water. Roads were included in the analysis and added to eliminate areas that are unsuitable for planting. A building point layer was provided by the City, but could not be included in the analysis (a polygon building layer is required to include in image classification). Once finalized, the land cover data was the input to assessing boundaries to provide UTC metrics at multiple scales.

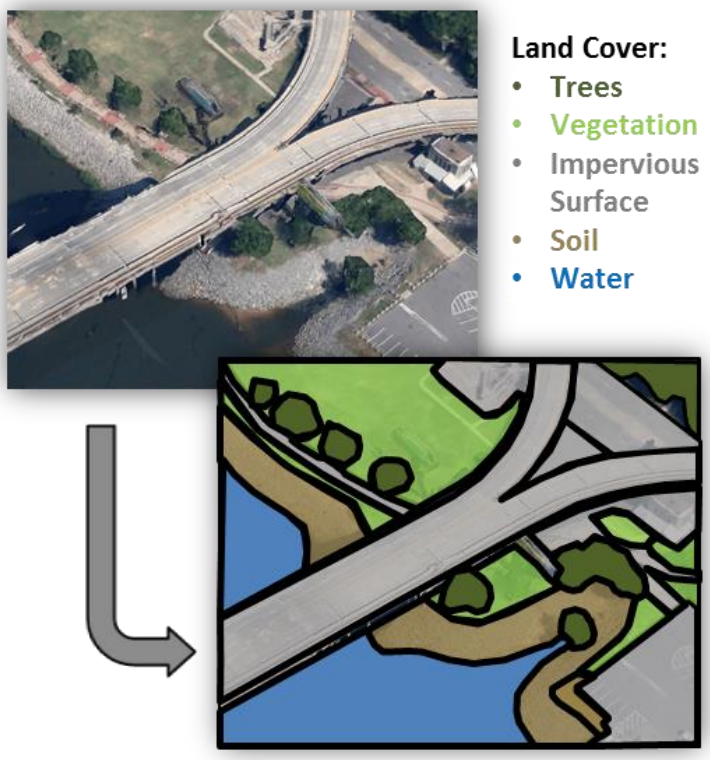


Figure 3: Accurate land cover mapping is the foundation of a UTC assessment.

URBAN FORESTS GIVE BACK

Urban forests are an integral part of the character for many residents and policy makers in the City of Jackson. Benefits of trees are referred to as "ecosystem services", and describe the ways that urban forests impact our lives and the environment. The information below outlines and justifies the many reasons to promote, establish, manage, and maintain a robust, "working" urban forest in Jackson.

A Better Place to Live, Work, and Play:

Environmental

Air Quality – trees absorb, trap, offset and hold air pollutants such as particulate matter, ozone, sulfur dioxide, carbon monoxide, and CO2.
Water Quality and Stormwater Runoff Mitigation – trees infiltrate, evapotranspire, and intercept stormwater while also increasing soil permeability and ground water recharge.
Erosion control – tree roots hold soil together along stream banks and steep slopes.
Increased wildlife habitat – increases biodiversity in urban areas

Economic

Property value –residential homes with healthy trees add property value (up to 15%).
Energy conservation – trees lower energy demand through summer shade and winter wind block, additionally offsetting carbon emissions at the power plant.
Stormwater facilities – trees and forests reduce the need for or size of costly gray infrastructure.

Social

Public health – trees help reduce asthma rates and reduce UV-B exposure by about 50%
Crime and domestic violence – urban forests help build stronger communities. Nature and trees provide settings in which relationships grow stronger and violence is reduced.
Noise pollution – Trees reduce noise pollution by acting as a buffer and absorbing up to 50% of urban noise (U.S. Department of Energy study).

Resources to Manage Tree Inventory and Monetize Urban Forest Benefits:

i-Tree Tools: Software suite from the USDA Forest Service that delivers urban forestry benefits and analysis assessment tools. http://www.itreetools.org/

The UF Cloud: With tools such as *Canopy Tracker, Simulate Canopy, Prioritize, and Update Metrics,* Plan-It Geo's Urban Forest Cloud applications, allow users to design and print maps of tree planting plans. This can increase volunteerism and community outreach, and tree's environmental services. For more information, visit: http://www.planitgeo.com/

TERMINOLOGY

Land cover classes were grouped into UTC Types for the assessment. UTC types categorize the landscape so that metrics can be summarized across spatial scales consistently for different applications. These terms are the metrics used in the project, and the following page illustrates the boundaries the metrics were used for They also target land uses, neighborhoods, natural areas, or individual properties for tree planting activities and policies.

UTC Types assessed in this Report:

- ***Existing UTC*** comprises forests and individual trees when viewed and mapped from above.
- ***Possible Planting Areas - Vegetation*** is the total area of grass and open space where tree canopy does not exist and it is biophysically possible to plant trees.
- ***Total Impervious*** is the total area of paved, hardscape surfaces (e.g. roads, buildings, parking lots, etc.) that contribute to urban heat islands and stormwater runoff (Note: due to overhanging tree canopy onto roads, sidewalks, and buildings, the total impervious acreage is reported lower than physical values).
- ***Unsuitable UTC*** - the combination of soil, roads, water and other areas where it is not feasible to plant trees. Building area is typically included however was not available when requested.

UTC types were mapped across GIS boundaries, described below. From the city to the parcel-level, the area and percent of these UTC types was calculated for map-making and Excel summaries.

Existing Urban Tree Canopy:

Planting Area Vegetation:

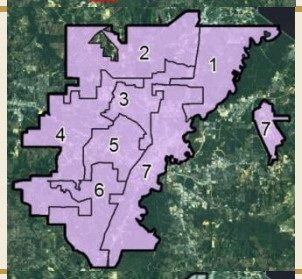
Total Impervious:

Unsuitable UTC:

UTC Assessment Boundaries

Assessment boundaries provide geographic units linked to where we live, work and play. Metrics for UTC Types were assessed for the GIS boundaries in Table 1. These summaries provide data for resource managers and planners at different spatial scales. The results are presented in ways that show examples of applying the data and results for aspects of Sustainability.

Table 1: Five (5) assessment boundaries examined in Jackson

Assessment Boundary	# of Types or Features	Description	Map
City Limits	1	Jackson City Limits	
Wards	7	Divisions of Jackson for representative, electoral, or administrative purposes	
Drainage Basins	17	Natural regions that are drained by different river systems into a common waterway	
Census Blocks	4,543	2010 U.S. Census data provides demographic data at the tract, block group, and block level. The most detailed 'block' level was assessed for this project.	
Parcels	80,753	Tax lots from the county assessors property database	

'Green' Initiatives Within Jackson

The City of Jackson has launched a 'Going Green' initiative within the City's Public Works Division. This movement supports a sustainable community in Jackson and surrounding areas. Protecting and increasing tree canopy in Jackson directly and indirectly provides an answer to the concerns outlined online and below:

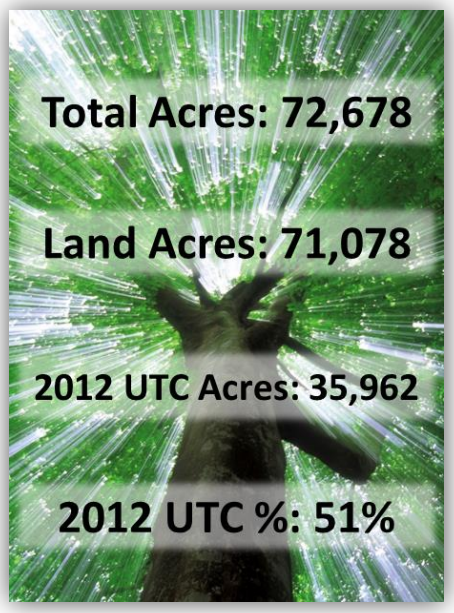
Developing Concerns	Solution Trees Provide
Conserving water and other natural resources	Trees capture, store, and filter stormwater
Reducing Energy Use	Strategically placed trees around homes save energy
Recycling and using renewable materials	Wood and Mulch are renewable materials
Reducing pollution and other negative effects on the environment	Trees directly remove pollutants from the air
Save taxpayer's money on energy costs	Trees reduce energy costs on residential properties
Preserve and sustain resources for future generations	Preservation of mature trees for future generations
Provide a greener, more enjoyable city environment for the citizens	Trees promote exercise, reduce crime, and add to overall quality of life
Have an impact on climate change	Trees reduce carbon emissions

Why a UTC Assessment Matters to you:

Going Green: The City of Jackson is working to become a "green city" by striving to promote a culture of "green" awareness. This UTC assessment is a step in the right direction to promote a vibrant and sustainable urban forest in the City of Jackson: http://www.jacksonms.gov/government/publicworks/goinggreen

ASSESSMENT RESULTS AND PRODUCTS

The boundaries assessed in the Jackson's UTC study are governed, owned, managed, and used in different ways by diverse constituents in the community. Therefore the UTC data and analysis results are presented for multiple scales and purposes to inform planners, managers and citizens alike. The following sections present canopy cover and planting potential at various scales and describe how the cities can use the data to develop better ways to manage this important resource.



Tree Canopy in Jackson

This study encompasses 72,678 acres defined by the city limits of Jackson and provides a snapshot of land cover based on 2012 aerial imagery. Tree canopy covers 35,962 acres (51%) of Jackson (based on total area including water). The predominate land cover types for the study area are vegetation (grass and open space) at 16,342 acres (23%) and impervious surfaces (roads, buildings, parking lots, driveways, patios, and other paved surfaces) at 16,986 acres. Water covers 2% of the City's area and "bare soil/dry vegetation" covers 1,788 acres, or 3% of Jackson.

Trees & Sustainability

A flourishing urban forest is an essential element within the sustainability framework. The results from this assessment are presented within 3 sustainability topic areas: ***Policy & Planning, Energy Conservation, and Stormwater Management***. Throughout each theme, four (4) key components are provided:

- What is each urban forest topic area
- Ways urban forests relate to the theme
- How this assessment provides the information needed
- What related resources the city may use to implement action.

The EPA defines sustainability ***as that which creates and maintains the conditions that humans and nature can exist in productive harmony for present and future*** **generations.**

LAND COVER IN JACKSON

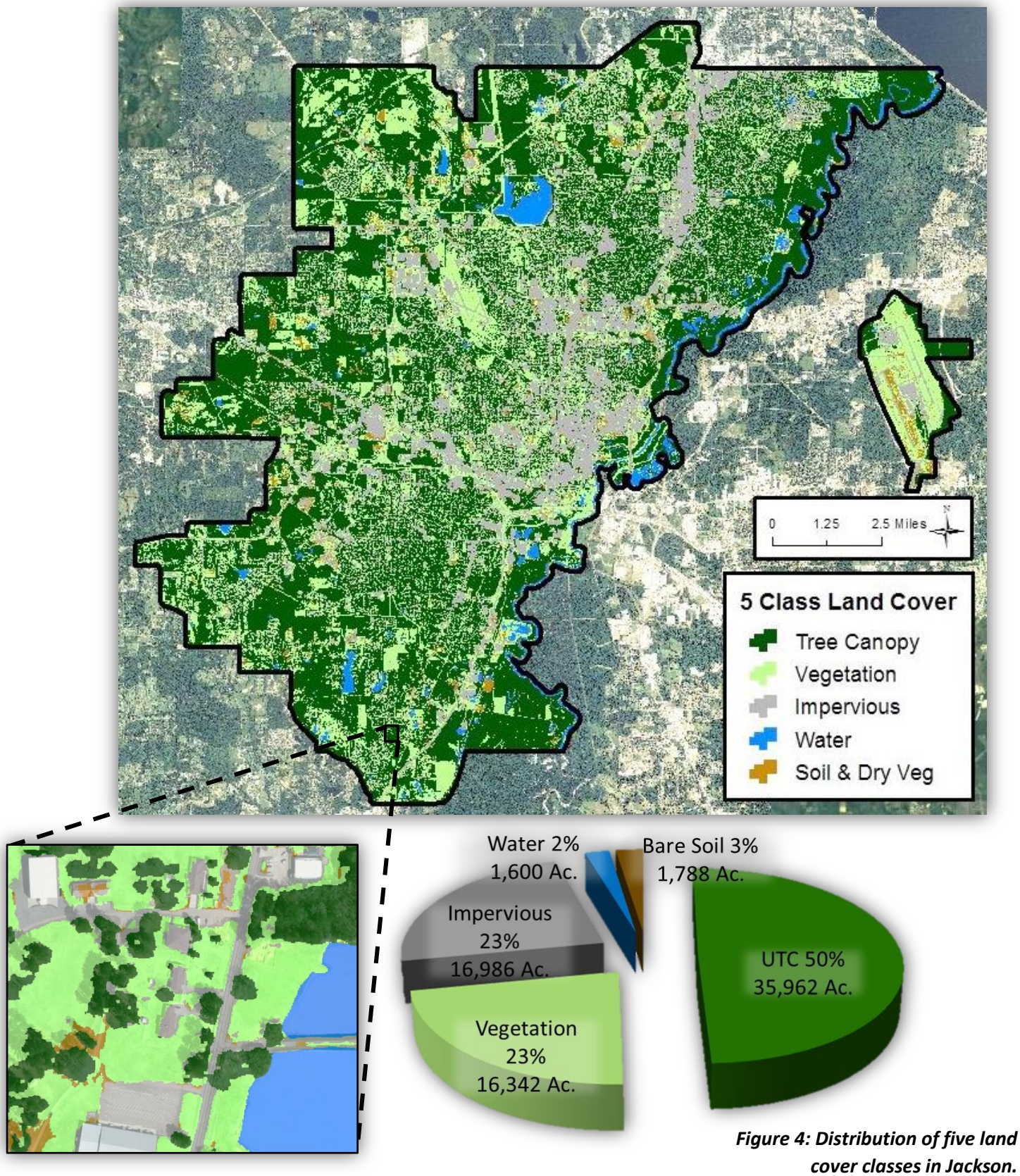


Figure 4: Distribution of five land cover classes in Jackson.

POLICY & PLANNING

Policy & Planning within Wards

The City of Jackson exhibits an impressive 51% UTC; a laudable achievement and contribution towards the City's overall sustainability and greening efforts Planners should focus on protection and maintenance of these landscapes. Council members have direct influence on development patterns and policies within their ward. Therefore, wards in Jackson were assessed as a benchmark of *green vs. gray* infrastructure, for council members to understand their urban tree canopy, and allocate forest management and conservation resources and efforts optimally.

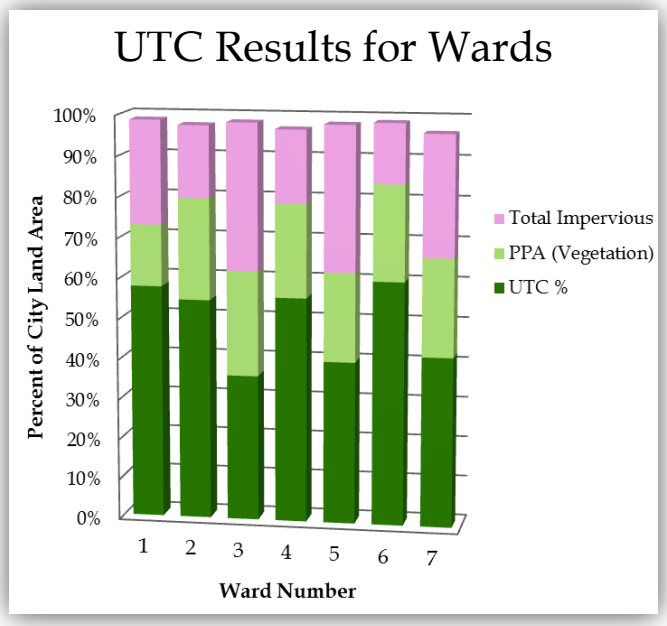


Figure 5: UTC Metrics within Jackson's wards.

Tree Canopy by Wards

In Jackson's seven wards, UTC ranged from 36% (2,022 acres in Ward 3) to 60% (5,139 acres in Ward 6). The following pages illustrate how authorities can use the assessment data to focus resources on planting and ***tree protection*** within their own ward, and contribute to the overall sustainability of the City for future generations.

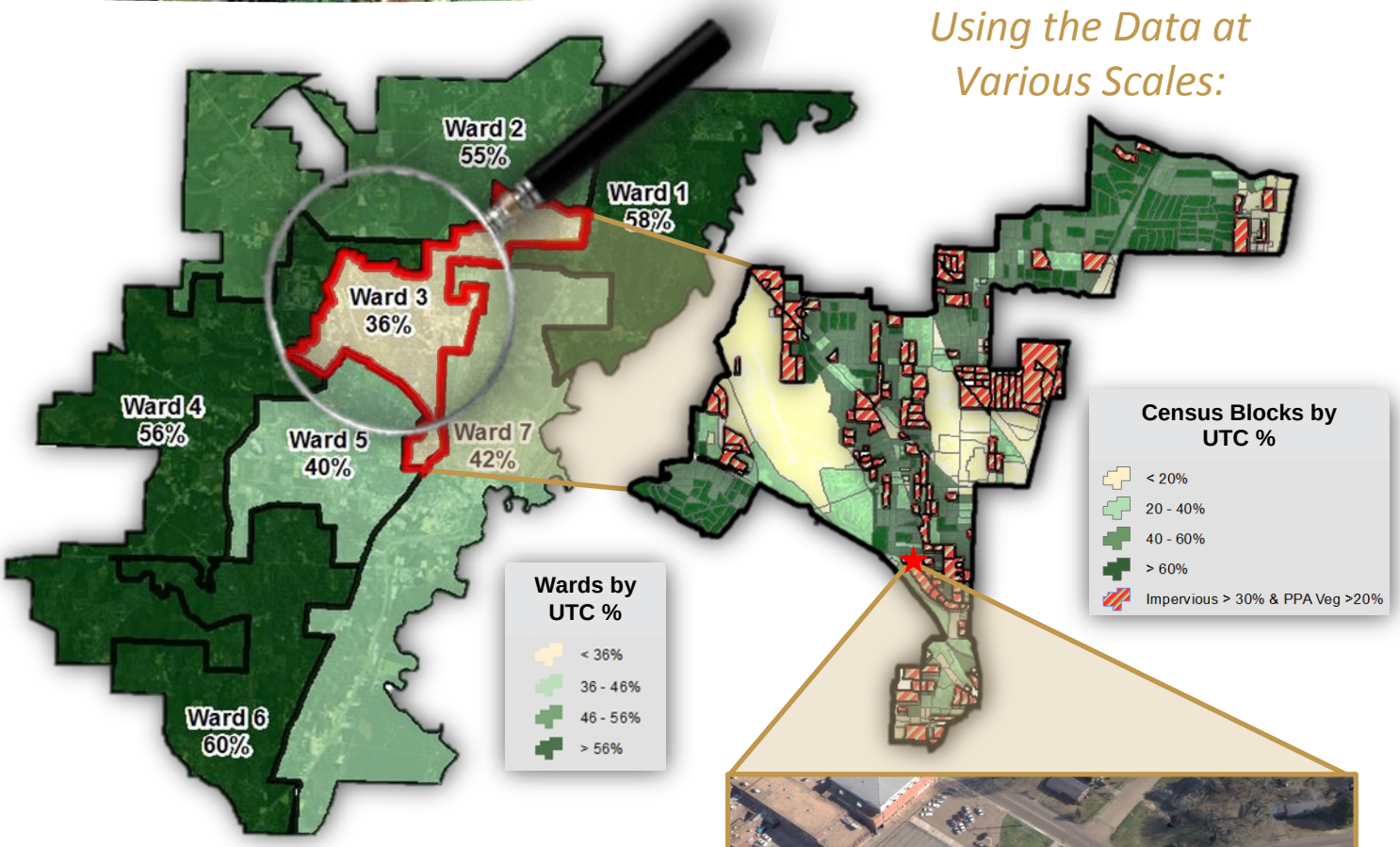
While 36% UTC in Ward 3 is commendable for a highly developed urban part of Jackson, a 'drill-down' approach on the following page uses Wards, Census Blocks, and Parcels to identify areas where additional tree canopy would contribute greatest to overall environmental services (mitigating the urban heat island effect, managing stormwater, improved air quality, etc.). Similar areas for planting or canopy protection/preservation can be quickly generated by ward.

We *all* Impact UTC:

Within the City of Jackson, the fate of urban forests relies upon City planners, council members, business owners, and residents alike. Sustainable community efforts must be met by all parties of Jackson in order for the City's urban forest to thrive. Local involvement includes:

- Establishing and enforcing tree preservation ordinances across all zoning types.
- Community outreach to educate residents of the economic and health benefits of trees and provide incentives to promote tree planting on private property.
- Preserving or offsetting existing tree canopy in areas at risk to forest loss (i.e. development pressures, storms, etc.), and planned maintenance of mature trees.
- Involvement from the Green Committee and City council members in development of an *urban forest management plan*.

Using the Data at Various Scales:



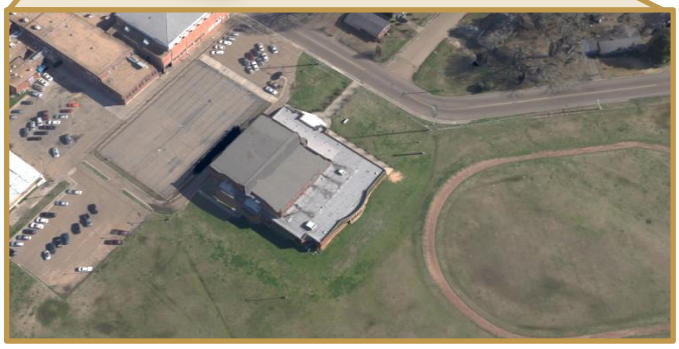


Figure 6: (Top Left): Percent UTC by Wards in Jackson.

Figure 7 (Top Right): Percent UTC in Ward 3 by Census Blocks. Areas highlighted have more than 30% Impervious Area and 20% planting potential (PPA Vegetation).

Figure 8 (Right): This school property has more than 30% impervious surface cover and more than 20% plantable area.

Utilizing the Data:

Ensuring that the City of Jackson's tree canopy directly contributes to a sustainable environment across all economic, social, and political boundaries, the City must use the data provided to promote planting in possible planting areas, and protect areas of high urban tree canopy from deforestation. Council members within each Ward may take their existing tree canopy percent and compare to their total possible planting area, and determine:

- Whether tree planting, tree preservation, or forest regeneration should be an objective.
- 'Drill-down' using finer scale boundaries, such as census blocks or parcels to determine exactly where *on the ground* tree canopy may be enhanced.
- How the Ward officials may develop tree preservation or tree planting ordinances throughout their jurisdiction.

ENERGY CONSERVATION AND TREE CANOPY

Energy Benefits of Trees

Urban forests are an integral part of the area's character for many residents in the City of Jackson. Reducing energy use and saving taxpayer's money on energy costs were fundamental issues addressed by Jackson's 'Going Green' initiative. Trees provide many energy saving benefits to a home. The following page demonstrates the monetary gains of strategically placed trees on a residential property. These gains are derived by using i-Tree Design, a tool developed by the U.S. Forest Service to calculate the benefits an individual tree can provide on a property.

Establishing Energy Benefits by Jackson's Parcels

Tree canopy data at the parcel-level allows the City to determine neighborhoods where tree canopy is low and provide outreach or incentives to residents. Of Jackson's 60,675 residential sized parcels (lots under 18,000 sq. ft.), 8,000 have less than 20% tree canopy. Increasing tree canopy on these lots can save homeowners money on energy bills, additionally offsetting carbon emissions at the power plant. Furthermore, the 2010 Census Data delineated roughly 4,543 census blocks in Jackson. 724 have less than 20% tree canopy but greater than 15% planting area, and could be targeted for expanding tree cover.

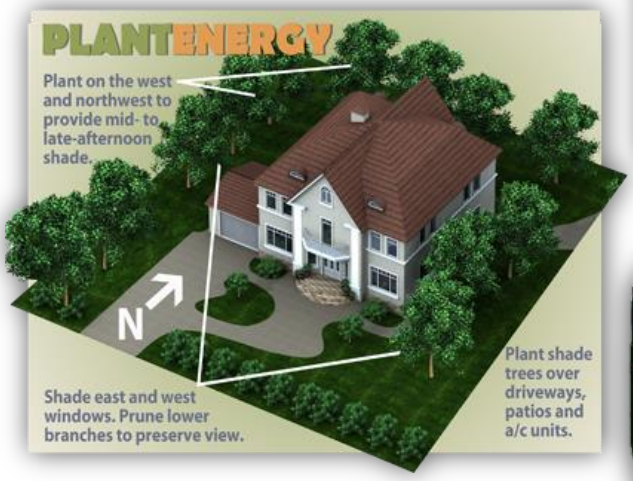


Figure 8: How strategically planted trees optimize energy efficiency in your home.
http://www.treesnashville.org/benefits.html

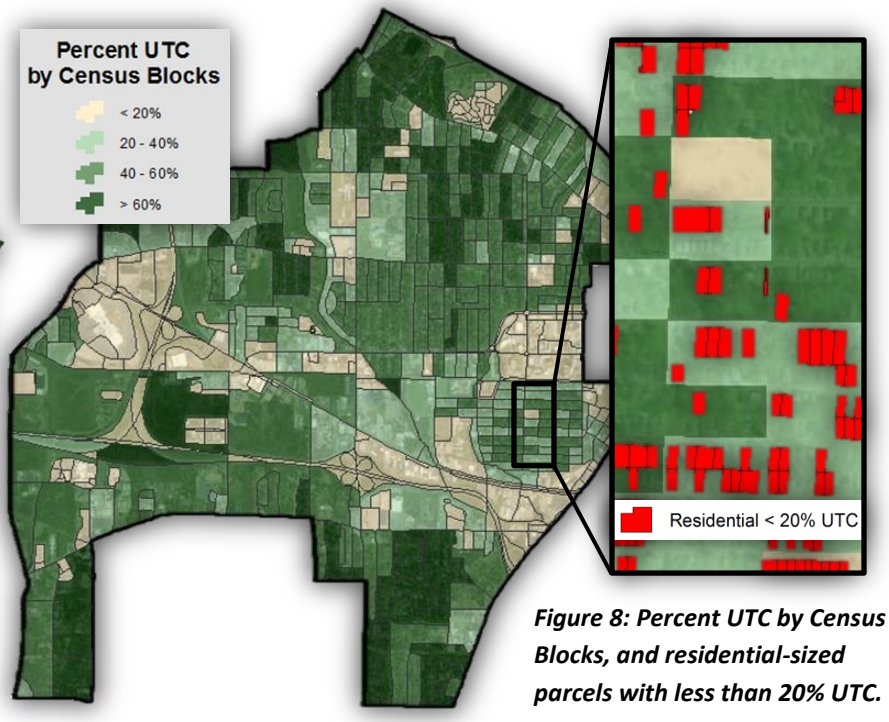


Figure 8: Percent UTC by Census Blocks, and residential-sized parcels with less than 20% UTC.

Energy Benefits of Trees:

- The U.S Department of Energy has found that properly placed trees can save homeowners up to 50% on their energy bills.
- Shading reduces the amount of heat absorbed and stored by buildings.
- Trees slow winds, which reduces the amount of heat lost from a home, especially where conductivity is high.
- Trees cool the air through evapotranspiration

For more information from the U.S. Department of Energy, visit:
http://www1.eere.energy.gov/library/pdfs/16632.pdf

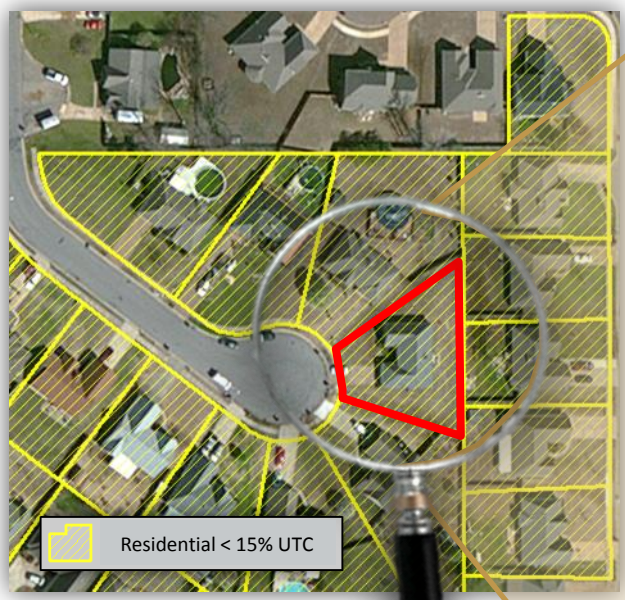


Figure 10:

New residential neighborhood with less than 15% tree canopy.

Figure 9:

i-Tree Design monetized tree planting benefits on a residential property.

Using i-Tree Design software, ecosystem benefits were monetized by strategic tree planting on a residential home. The sum annual savings of planting three (3) deciduous trees on this property would result in $232.50, a total energy savings of $33.80 annually. Public outreach and education of these benefits provide an incentive for residents to plant trees on private properties and for city leaders to focus policies and funding on maintaining existing large trees.

Related Resources:

The Arbor Day Foundation's "Energy Saving Trees" program is a research-based tool intended to help homeowners and utility companies save energy and money by strategically planting trees. Encouraging the City of Jackson's utility company to become partners with the Arbor Day Foundation will save energy and money for the entire County, while encouraging tree planting. *For more information, visit:* http://energysavingtrees.arborday.org/#Home

Planting Incentive Example: Montgomery County, MD's Planning "Leaves for Neighborhoods" program: provides a subsidiary to private homeowners when they purchase new trees to plant on their property. *For more information, visit:* http://www.montgomeryplanning.org/events/leaves/

Stormwater Management and Tree Canopy

Stormwater Benefits of Trees

Tree canopy plays an important role in stormwater management. As new development occurs with increasing impervious surfaces, less rainwater may be stored by trees and infiltrated into groundwater, and more runoff enters nearby rivers, resulting in greater flood damages. Trees not only capture and store stormwater runoff in the canopy and release water back into the atmosphere by evapotranspiration, but also promote infiltration into the soil, and filter out harmful pollutants. Additionally, trees can save Jackson money on costly watershed infrastructure.

Figure 11: Floods in the Southern U.S. can cost millions in damages.

Drainage Basins and Tree Canopy

Tree canopy in Jackson's drainage basins ranged from 30% to 76%, while percent impervious surface ranged from 2% to 40%. By assessing UTC within drainage basins, the city may target watersheds with low UTC and high PPA and determine high priority planting areas. The example below selected the Town Creek Watershed, and selected parcels within 500 ft. of a creek. Using the land cover data, possible planting areas were highlighted in those parcels, and designated as available planting areas.

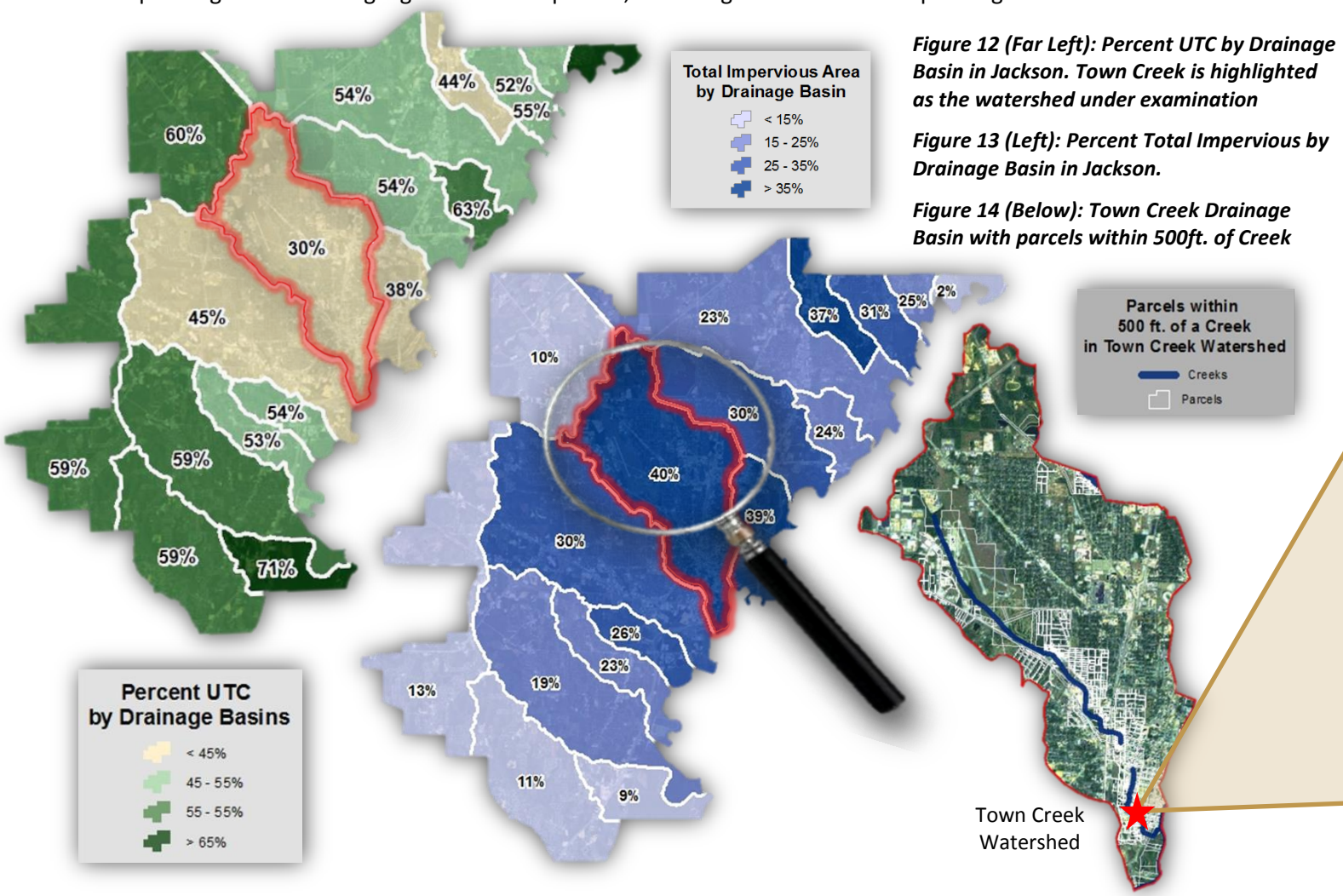


Figure 12 (Far Left): Percent UTC by Drainage Basin in Jackson. Town Creek is highlighted as the watershed under examination

Figure 13 (Left): Percent Total Impervious by Drainage Basin in Jackson.

Figure 14 (Below): Town Creek Drainage Basin with parcels within 500ft. of Creek

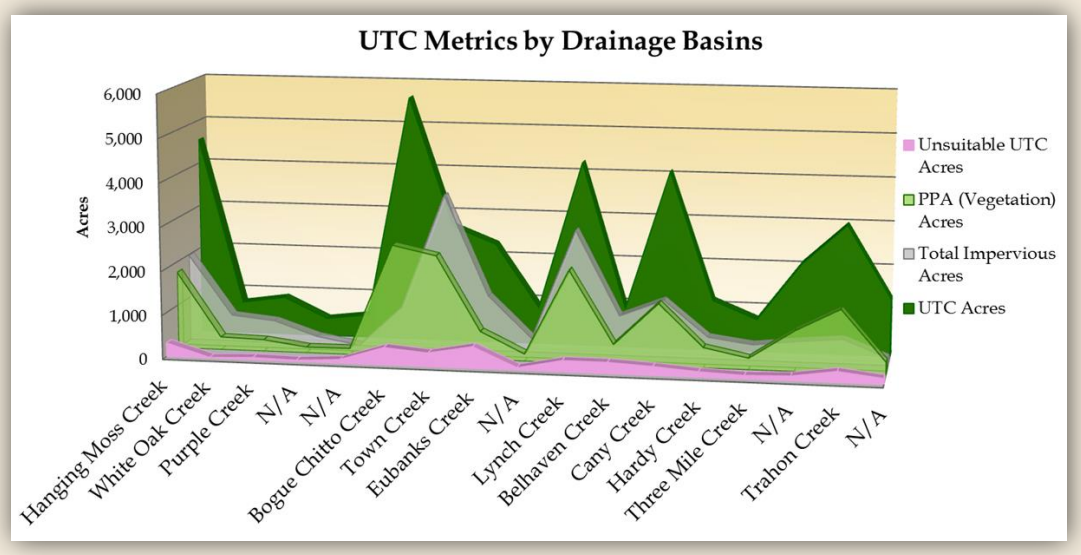


Figure 15: Line graph of UTC Metrics by Drainage Basins.

Figure 16 (Below): Impact of Hydrologic cycle due to development in Jackson.

http://www.jacksonms.gov/government/publicworks/swmp

Jackson's Public Works has developed a stormwater management program to address key issues related to the planning, maintenance, and regulation of facilities which collect, store, or convey stormwater. Areas with high impervious surfaces may be targeted for tree planting to help reduce the risk of flooding, and improve water quality within the water table.

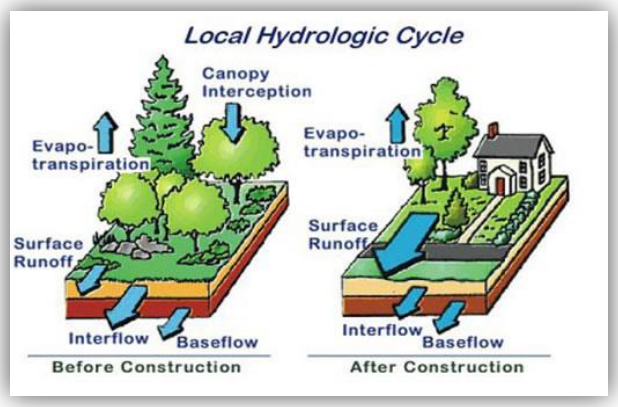


Figure 17: Optimal available planting areas in Town Creek watershed within 500ft of a creek.

Related Resources:

- The *Urban Watershed Manual Part 1: Methods for Increasing Forest Cover in a Watershed*, developed by the US Forest Service outlined techniques for maintaining and increasing current canopy within drainage basins. Table of goals and techniques provided in appendix. T*o read more, visit:* http://nemonet.uconn.edu/images/resources/FREMO/completepart1forestrymanual.pdf
- The EPA has developed a range of models to assess costs and environmental outcomes associated with green infrastructure approaches, such as effective tree planting, permeable pavement options, and retention ponds. *To learn more, visit:* http://water.epa.gov/infrastructure/greeninfrastructure/gi_modelingtools.cfm

RECOMMENDATIONS

Management of Jackson's urban forest requires planners to balance allocation of limited resources (time and money) and make choices that provide the best outcomes based on the environmental, social, and economic needs of all community members. To help support these decisions, below are recommendations that follow the organization of this report, describing ways to use the resources provided through this assessment and techniques to use over time that will lead to the enhancement of Jackson's urban forest.

LAND COVER ANALYSIS

- ✓ Disseminate the GIS land cover data layers broadly to diverse partners for use in urban forestry and other applications while the data is current.
- ✓ Work with diverse partners to integrate the land cover data into decision-making and implementation planning.
- ✓ Re-assess canopy cover in 8 to 10-year intervals using LiDAR data if available, aiming for 95% overall accuracy.
- ✓ Conduct tree planting along highway 80 and 18 corridors where tree canopy is low, and where canopy would reduce the impact of noise pollution and enhance air quality.

POLICY & PLANNING

- ✓ Develop a comprehensive urban forest management plan, and establish canopy goals by City or ward through development of implementation plans in a collaborative, multidisciplinary process. Reassess canopy periodically to measure progress toward goals and effectiveness of education/outreach and tree-related management and policies.
- ✓ Work closely with the Mississippi Forestry Commission, Urban Forestry South, and other neighboring communities to develop a regional plan for canopy growth.
- ✓ Using project data, tools, and results, develop targeted presentations for city leaders, planners, engineers, air and water quality managers, and others on the functional benefits of urban tree canopy in addressing critical regional issues.
- ✓ Host the UTC data layers in an online application focused on urban forest planning. Using the tool, work with towns, school boards, developers, environmental non-profits, and public health professionals to enable volunteerism and citizen science to advance urban tree canopy benefits.

ENERGY CONSERVATION

- ✓ Encourage homeowners to utilize free online tools such as i-Tree Design to determine proper placement of trees around their homes for energy benefit, and implement a targeted residential

tree planting campaign to reduce peak energy consumption. If successful, this program may expand to serve customers throughout other service areas.

- ✓ Encourage utility companies within the City of Jackson to become partners with the Arbor Day Foundation, and adopt the "Energy Saving Trees" program to save energy and money for city residents and businesses while encouraging tree planting.

Stormwater Management

- ✓ Utilize geospatial and UTC data in watershed planning to prioritize potential planting locations for protecting water quality.
- ✓ Encourage trees and forests as a Best Management Practice (BMP) in Green Infrastructure and Low Impact Development stormwater mitigation strategies, where appropriate.
- ✓ Develop a public/private incentive program to plant and maintain large trees in and around parking lots to reduce the urban heat island effect and flow of contaminated runoff into surface waters.
- ✓ Conduct an i-Tree Hydro ecosystems benefits analysis using the land cover data to determine the stormwater impact of trees and forests under various future management scenarios.
- ✓ Allocate planting resources along riparian corridors and areas of high impervious surface cover to help prevent flooding and erosion, and promote groundwater recharge.
- ✓ Focus tree planting for storm preparedness in drainage basins with low tree canopy, and high impervious surfaces, such as Town Creek.

Canopy Protection and Preservation

- ✓ Assess the land cover data by land use and develop citywide and specific land use canopy goals.
- ✓ Map, quantify, and protect developable lands at risk of forest loss by land use categories.
- ✓ Manage current trees and forests for safety, invasive species, and storm damage.
- ✓ Evaluate effectiveness of street tree, parking lot, and tree protection ordinances.

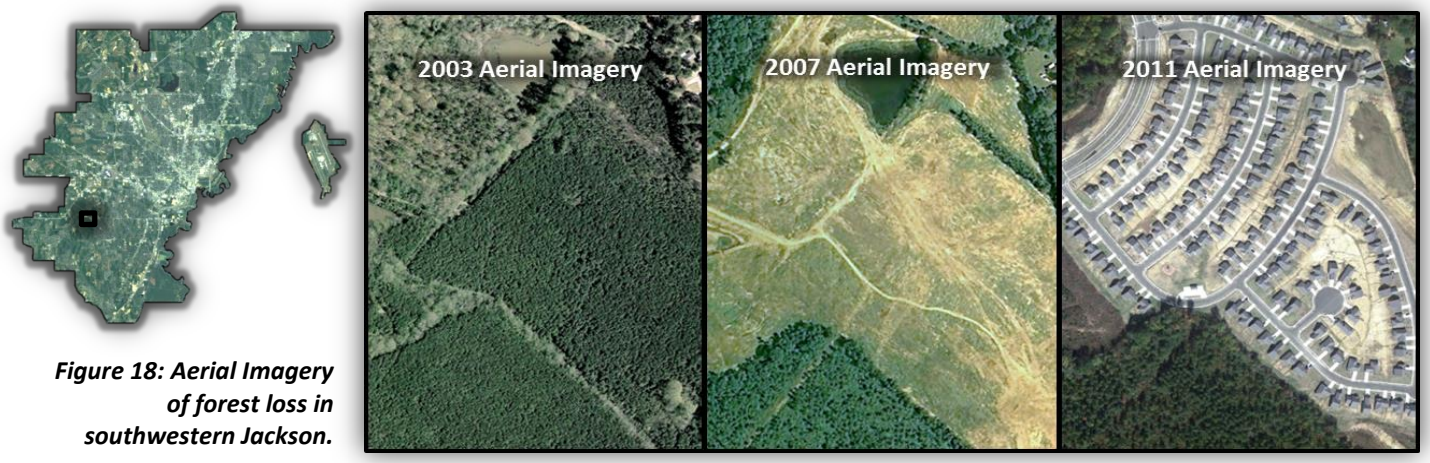


Figure 18: Aerial Imagery of forest loss in southwestern Jackson.

SUMMARY

Urban forests are dynamic resources that are constantly changing through natural and human processes. Managing urban forests effectively over time requires an understanding of where trees are presently, where they can be planted equitably to maximize benefits, and how to overcome regulatory and physical restrictions that impede goals.

This 2013 UTC assessment provides the City of Jackson with an accurate and dependable tree inventory benchmark for the City, and a customized analysis and report tailored to assist in the City's near and long-term vision of urban natural resource management.

Highlights from this study:

- Data from this study indicates that 51% (35,962 acres) of Jackson's city limits are covered by tree canopy, with nearly 23% (16,342 acres) of Jackson's land area available for possible planting (PPA Vegetation).
- Jackson's 7 Wards ranged from 36% UTC (2,022 acres in Ward 3) to 60% UTC (5,139 acres in Ward 6).
- Ward 3 has the highest total possible planting area (PPA Vegetation) at 26% (1,458 acres) while Ward 1 has the lowest PPA Vegetation at 15% (1,305 acres).
- Of Jackson's 17 Drainage Basins, Basin 6 has the highest UTC at 76% (532 acres), while Basin 9 (Town Creek) has the lowest UTC at 30% (2,685 acres).
- Drainage Basin 9 (Town Creek Watershed) has the most acres of Total Impervious at 3,556 acres. Tree planting for stormwater management should be a focus in Town Creek
- The 2010 Census Data delineated roughly 4,543 census blocks in Jackson. 724 have less than 20% tree canopy but greater than 15% planting area, and could be targeted for expanding tree cover.

The Future of Canopy in the City of Jackson

A detailed an accurate baseline of land cover has been thoroughly analyzed and presented in this report. An ongoing challenge will be to balance new development with the protection and conservation of environmental values related to forest cover, such as energy conservation, air quality, and climate adaptation related to carbon storage and stormwater mitigation. The social, environmental, and economic benefits of urban trees and forests are an incentive to continue in this direction.

APPENDIX

Additional details on the City of Jackson's 2013 urban tree canopy assessment are provided including supporting information on:

A1: Glossary of Terms

A2: Complete Ward & Drainage Basin Results

A3: Urban Forest Self Evaluation; Criteria & Indicators

A4: Canopy Calculator

A5: USFS Table for Increasing Forest Cover within Watersheds

A6: Land Cover Classification Accuracy Assessment

A1: Glossary of Terms

Air Quality – The quantity of particulates and other pollutants present in a volume of air relative to necessary compounds such as oxygen. Trees improve air quality by absorbing and trapping air pollutants such as particulate matter, ozone, sulfur dioxide, carbon monoxide, and CO^2 and by decreasing volatility by lowering air temperatures.

Carbon Sequestration – The rate that carbon is removed from the atmosphere by trees. Carbon is considered a very important element because of its recognized influence on climate regulation as a greenhouse gas.

Carbon Storage – Cumulative amount of carbon stored in the stems, branches and roots of trees over time.

Ecosystem Services – Direct and indirect benefits provided by natural systems. The most common ecosystem services associated with urban trees and forests are air quality improvement, carbon sequestration and storage, energy conservation, and storm water mitigation.

Energy conservation – The amount of energy saved due to the presence of trees. Summer cooling through shade, and by wind blocking in the winter reduces total energy used.

Geographic Information Systems – Computer mapping systems used to understand how resources are distributed across the Earth's surface.

Green VS. Gray Infrastructure – According to the EPA, gray infrastructure refers to traditional practices for stormwater management and wastewater treatment, such as pipes and sewers. Green infrastructure refers to sustainable pollution reducing practices that also provide other ecosystem services.

Impervious Land Cover – Hardscape surfaces that do not allow rainfall to infiltrate the soil (Buildings, roads, parking lots).

i-Tree Design– As part of the i-Tree suite developed by the USDA Forest Service, this tool calculates benefits of trees on a property

PPA Vegetation – (Possible Planting Area) associated with vegetation and open space. These are areas where tree planting is possible.

Urban Heat Island Effect – refers to developed areas that are hotter than surrounding rural areas due to the abundance of man-made materials which absorb the sun's energy much more than trees or other plants, and in turn warm the air around them (Center for Environmental Studies, Brown University, "Trees and the Urban Heat Island Effect", 2010).

UTC – (Urban Tree Canopy) is defined as the layer of leaves and stems of trees that cover the ground when viewed from above.

Stormwater Runoff Mitigation and Water Quality – Important ecosystem services related to precipitation events, hydrologic cycles, and urban forests. Trees reduce stormwater runoff and improve water quality by intercepting rainfall, increasing soil permeability, and evapotranspiration.

A2: Complete Ward & Drainage Basin Results

The following maps and tables on pages 25-28 provide more comprehensive results for each boundary assessed in this study.

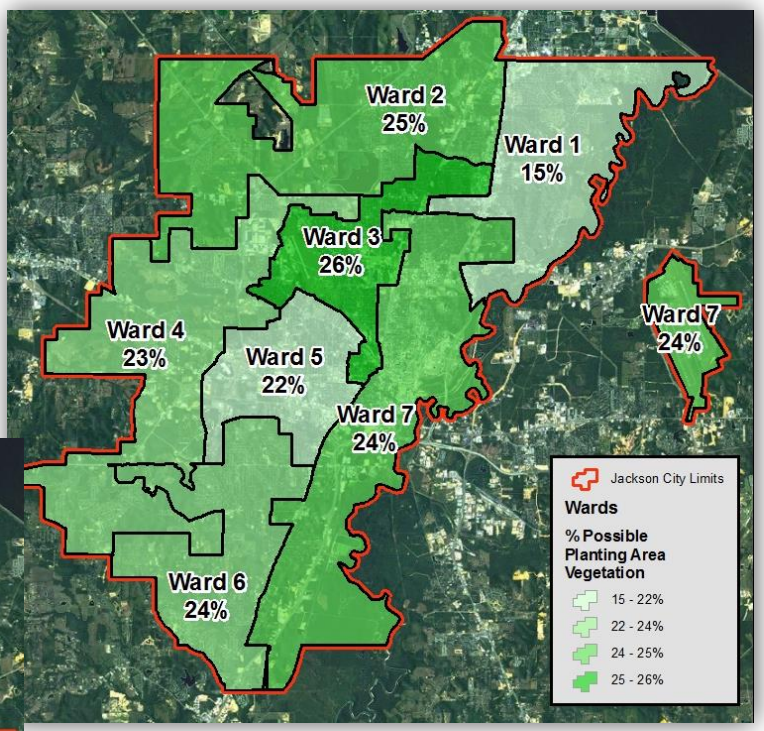


Figure 19: Percent possible planting area Vegetation by Wards

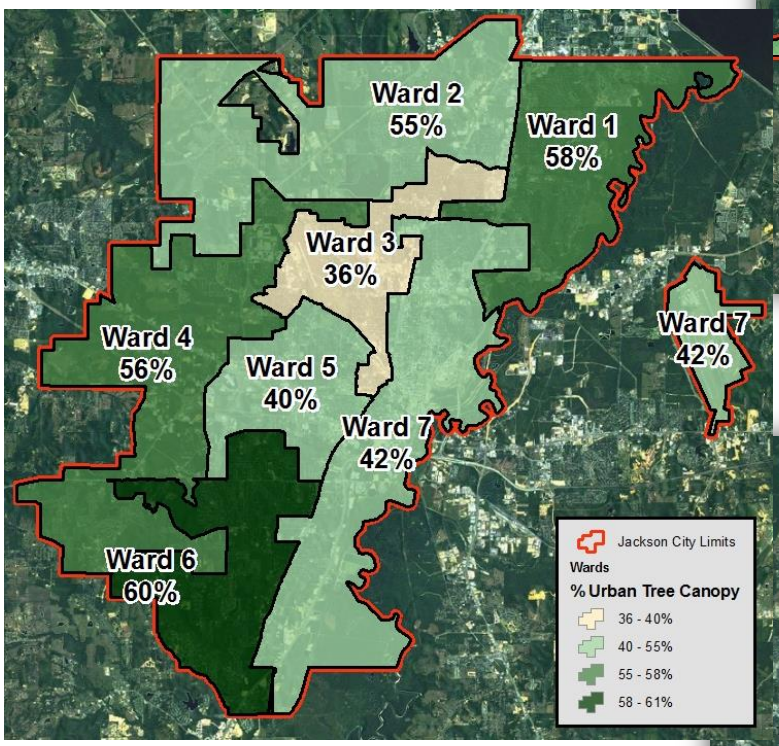


Figure 20: Percent UTC by Wards

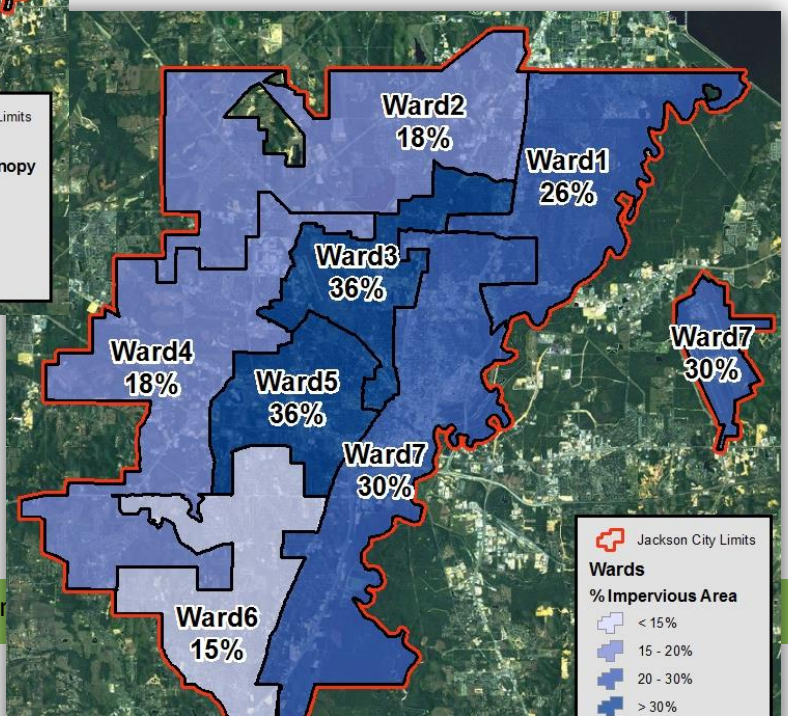


Figure 21: Percent impervious surfaces by Wards

Table A2-1: Complete UTC results for Jackson wards

Ward	Land Acres (Excludes Water)	UTC Acres	UTC %	Percent of Total UTC in Jackson	PPA (Vegetation) Acres	PPA (Vegetation) %	Total Impervious Acres	Total Impervious %	Unsuitable UTC Acres	Unsuitable UTC %
1	8,587	4,957	58%	14%	1,305	15%	2,204	26%	521	6%
2	13,677	7,469	55%	21%	3,433	25%	2,425	18%	796	6%
3	5,609	2,022	36%	6%	1,458	26%	2,033	36%	100	2%
4	13,820	7,698	56%	21%	3,185	23%	2,492	18%	540	4%
5	5,594	2,250	40%	6%	1,232	22%	2,006	36%	113	2%
6	8,519	5,139	60%	14%	2,018	24%	1,254	15%	278	3%
7	15,251	6,423	42%	18%	3,705	24%	4,561	30%	1,040	7%
TOTAL	**71,057**	**35,958**	**51%**	**100%**	**16,336**	**23%**	**16,976**	**24%**	**3,387**	**5%**

Tree Canopy, Possible Planting Area, and Impervious Surfaces by Drainage Basins

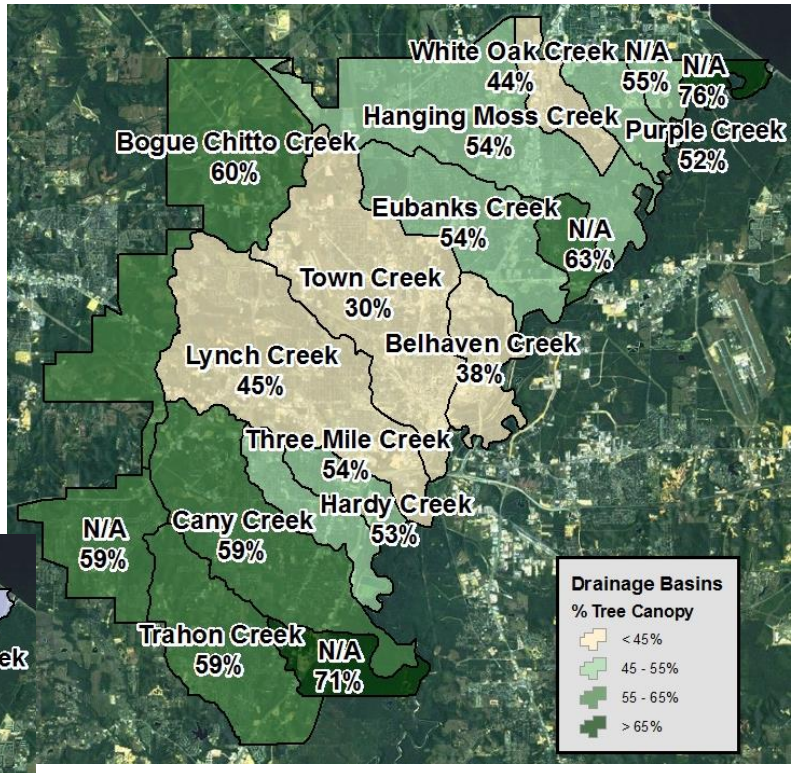
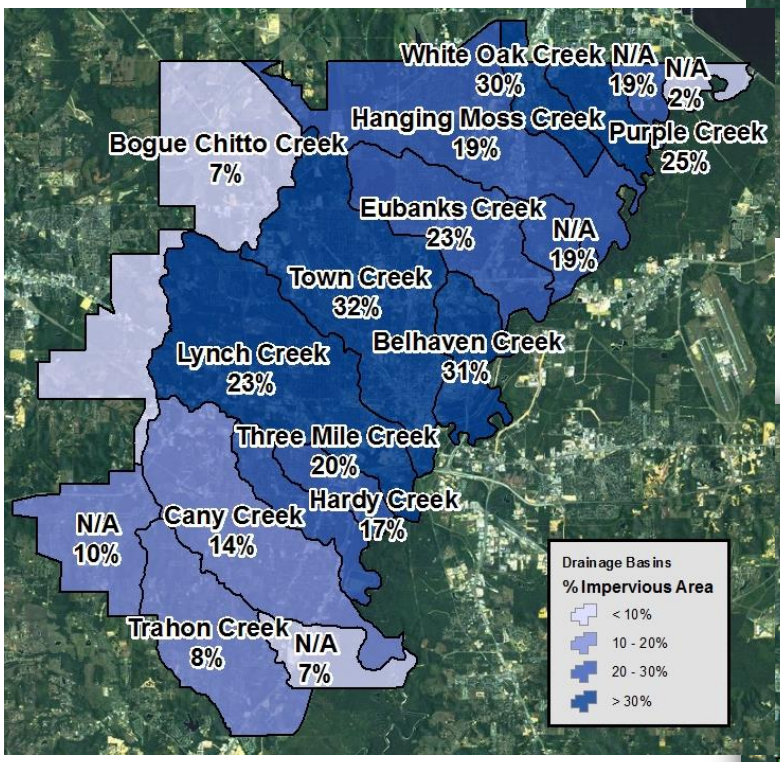


Figure 20: Percent UTC by Drainage Basin

Figure 20: Percent Impervious Surfaces by Drainage Basin



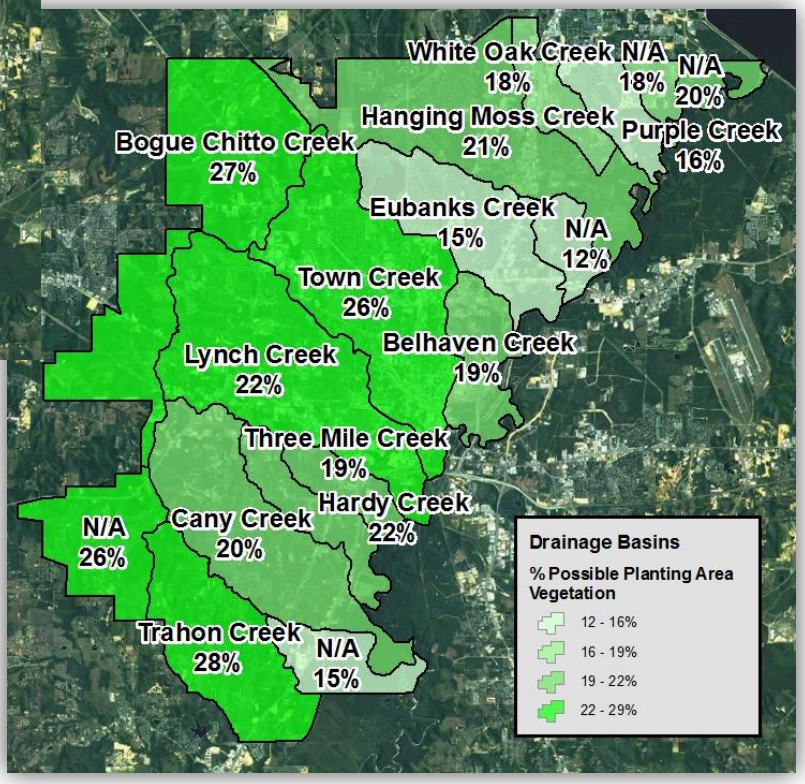


Figure 20: Percent Possible Planting Area Vegetation by Drainage Basin

Table A2-2: Complete UTC results for Jackson drainage basins

Watershed	Total Land Acres	UTC Acres	UTC %	% of Total UTC	PPA (Veg.) Acres	PPA (Veg.) %	Total Imp. Acres	Total Imp. %	Uns. UTC Acres	Uns. UTC %
Hanging Moss Creek	8,469	4,543	54%	13%	1,761	21%	1,984	23%	316	4%
White Oak Creek	1,654	730	44%	2%	295	18%	610	37%	21	1%
Purple Creek	1,676	876	52%	2%	267	16%	515	31%	55	3%
N/A	742	411	55%	1%	135	18%	183	25%	34	5%
N/A	702	532	76%	1%	140	20%	13	2%	90	13%
Bogue Chitto Creek	9,432	5,635	60%	16%	2,545	27%	938	10%	401	4%
Town Creek	8,828	2,685	30%	7%	2,336	26%	3,556	40%	315	4%
Eubanks Creek	4,287	2,295	54%	6%	642	15%	1,271	30%	497	12%
N/A	1,341	847	63%	2%	167	12%	320	24%	60	4%
Lynch Creek	9,392	4,235	45%	12%	2,108	22%	2,834	30%	261	3%
Belhaven Creek	2,362	895	38%	2%	458	19%	915	39%	258	11%
Cany Creek	6,947	4,077	59%	11%	1,422	20%	1,308	19%	205	3%
Hardy Creek	2,162	1,152	53%	3%	465	22%	499	23%	127	6%
Three Mile Creek	1,390	745	54%	2%	264	19%	363	26%	86	6%
N/A	3,522	2,065	59%	6%	916	26%	475	13%	113	3%
Trahon Creek	5,063	2,976	59%	8%	1,435	28%	562	11%	254	5%
N/A	1,864	1,324	71%	4%	287	15%	175	9%	135	7%
TOTALS	**69,833**	**36,021**	**52%**	**100%**	**15,644**	**22%**	**16,521**	**24%**	**3,230**	**5%**

A3: Urban Forest Self Evaluation; Criteria & Indicators

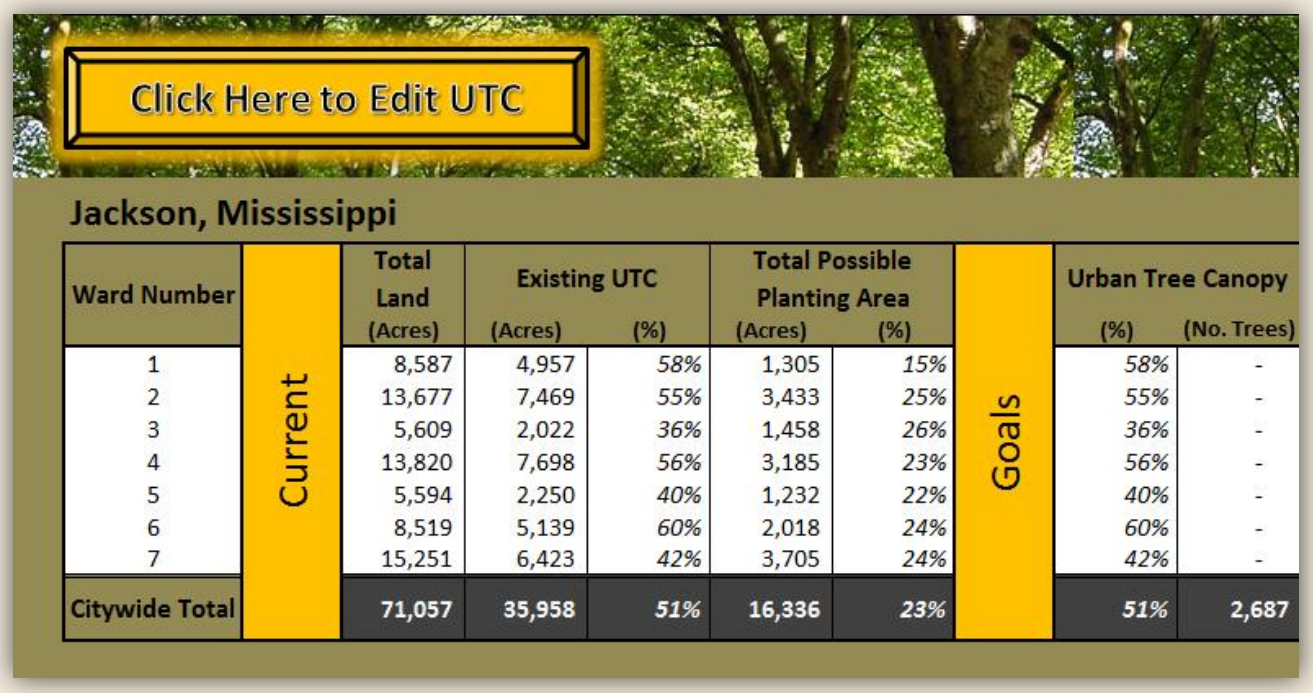
The table below illustrates *Criteria and Indicators* (Clark 1997) to self-evaluate various components necessary for an effective and sustainable urban forest model. This is a useful tool in guiding the process of developing an urban forest management plan.

Criteria	Performance Indicator Spectrum	Key Objectives
Vegetative Resource	V1: Relative Canopy Cover V2: Age Distribution of trees V3: Species Suitability & Distribution V4: Condition of Public Trees V5: Publicly owned Natural Areas V6: Native Vegetation	V1: Appropriate amount of tree cover V2: Uneven Age Distribution of Trees V3: Genetically Diverse & Suitable Trees V4: Detailed Understanding of Tree Condition V5: Detailed understanding of Natural Areas V6: Enhancement of Native Vegetation
Community Framework	C1: Public Agency Cooperation C2: Private & Institutional Input C3: Green Industry Cooperation C4: Neighborhood Action C5: Citizen-Municipality-Business interaction C6: Resource Education C7: Regional Cooperation	C1: City Shares Common Goals C2: Embrace Objectives C3: Green Industry Commits to Goals C4: Citizens Commit to UF Management C5: Community Interaction of UF C6: Community Education of UF Role C7: Cooperation among neighboring communities
Resource Management	R1: Tree Inventory R2: **Canopy Cover Assessment** R3: City-wide Management Plan R4: Funding/Staffing R5: Tree Establishment and Planning R6: Maintenance of Public Trees R7: Tree Risk Management R8: Tree Protection Policies Development and Implementation R9: Publicly-owned Natural Areas Management	R1: Complete Up-to-date Tree Inventory R2: **High Resolution Assessments of Existing Conditions** R3: Develop/Implement UF Mgmt. Plan on public and private properties R4: Adequate Funding/Staffing for UF Mgmt. R5: UF Renewal ensured through Tree Establishment program R6: Trees Maintained to Maximize Benefits R7: All Public Trees are Safe R8: Structure of Natural Areas Protected and enforced by policies R9: Ecological Structure of Natural Areas Protected and Enhanced

**Performance Indicator Spectrum: For each criteria, objectively rank the current level of performance from: LOW, MODERATE, GOOD, OPTIMAL.

A4: Canopy Calculator

To assist in advanced UTC goal setting, Plan-It Geo's Canopy Calculator (MS Excel) tool is provided as an advanced but easy-to-use tool to the City of Jackson. The City may quickly and easily enter various goals and determine future tree canopy cover and tree planting scenarios.



Ward Number		Total Land (Acres)	Existing UTC (Acres)	Existing UTC (%)	Total Possible Planting Area (Acres)	Total Possible Planting Area (%)		Urban Tree Canopy (%)	Urban Tree Canopy (No. Trees)
1	Current	8,587	4,957	58%	1,305	15%	Goals	58%	-
2		13,677	7,469	55%	3,433	25%		55%	-
3		5,609	2,022	36%	1,458	26%		36%	-
4		13,820	7,698	56%	3,185	23%		56%	-
5		5,594	2,250	40%	1,232	22%		40%	-
6		8,519	5,139	60%	2,018	24%		60%	-
7		15,251	6,423	42%	3,705	24%		42%	-
Citywide Total		71,057	35,958	51%	16,336	23%		51%	2,687

	(+)		(+/-)		(-)		(+)		(=)			
Predictions	Natural Regeneration (Acres)	(%)	Canopy Growth & Mortality (Acres)	(%)	Loss to Development (Acres)	(%)	Tree Planting Required (Acres)	Trees)	Net UTC Increase (Acres)	(%)	UTC in 2013 (Acres)	(%)
	-	0%	-	0%	-	0%	23	1,093	23	0%	4,980	58%
	-	0%	-	0%	-	0%	53	2,486	53	1%	7,522	55%
	-	0%	-	0%	-	0%	(3)	(129)	(3)	0%	2,019	36%
	-	0%	-	0%	-	0%	41	1,920	41	1%	7,739	56%
	-	0%	-	0%	-	0%	(12)	(578)	(12)	-1%	2,238	40%
	-	0%	-	0%	-	0%	(28)	(1,286)	(28)	-1%	5,111	60%
	-	0%	-	0%	-	0%	(18)	(819)	(18)	0%	6,405	42%
	-	0%	-	0%	-	0%	58	2,687	58	0%	36,016	51%

*Change Calculated after 0 Years

*Regeneration, Growth, Mortality, and Loss may result in negative Planting numbers

Figure 21: Screenshots of Jackson's UTC Calculator

A5: USFS Table for Increasing Forest Cover Within Watersheds

Recommendations for maintaining and increasing forest cover, taken from the US Forest Service's Urban Watershed Forestry Manual, Part 1: Methods for Increasing Forest Cover in a Watershed.

Goals	Objectives	Techniques
Protect	A. Protect Priority Forests	1. Conservation easements 2. Land acquisition 3. Transfer of development rights
	B. Prevent Forest Loss During Development and Redevelopment	4. Bonus and incentive zoning 5. Clearing and grading requirements 6. Forest conservation regulations 7. Open space design 8. Overlay zoning 9. Performance-based zoning 10. Storm water credits 11. Stream buffer ordinances
	C. Maintain Existing Forest Canopy	12. Protection of significant trees 13. Tree removal restrictions for developed areas
Enhance	D. Enhance Forest Fragments	14. Increase forest area where possible 15. Increase habitat diversity 16. Manage deer 17. Protect soils from erosion and compaction 18. Provide food, cover, and nesting sites for wildlife 19. Reduce or eliminate invasive species 20. Remove trash and prevent dumping
Reforest	E. Plant Trees During Development and Redevelopment	21. Landscaping requirements 22. Planting trees in storm water treatment practices 23. Planting trees in other open areas 24. Shading and canopy requirements
	F. Reforest Public Land	25. Allow natural regeneration 26. Actively reforest public lands
	G. Reforest Private Land	27. Education 28. Incentives for tree planting 29. Stewardship and neighborhood action

Figure 22: Goals, objectives and techniques to increase forest cover within watersheds.

A6: Land Cover Classification Accuracy Assessment

Mississippi Land Cover Classifications

This report describes the methods used and generated results in mapping land cover types across the City of Jackson and County of Desoto, Mississippi. National Agricultural Inventory Program (NAIP) aerial photography from 2012 and GIS data were combined to map five land cover classes: (1) Tree Canopy, (2) Impervious Surface, (3) Green Vegetation, (4). Soil and Dry Vegetation, and (5) Water. Object-based image analysis (OBIA) was used to map trees, other vegetation, impervious surfaces and soil/dry vegetation areas. Impervious surfaces were augmented with existing buildings (provided by MS) and by buffering existing road centerlines. Water was mapped using features provided in addition to manual digitizing at 1:1,000 scale.

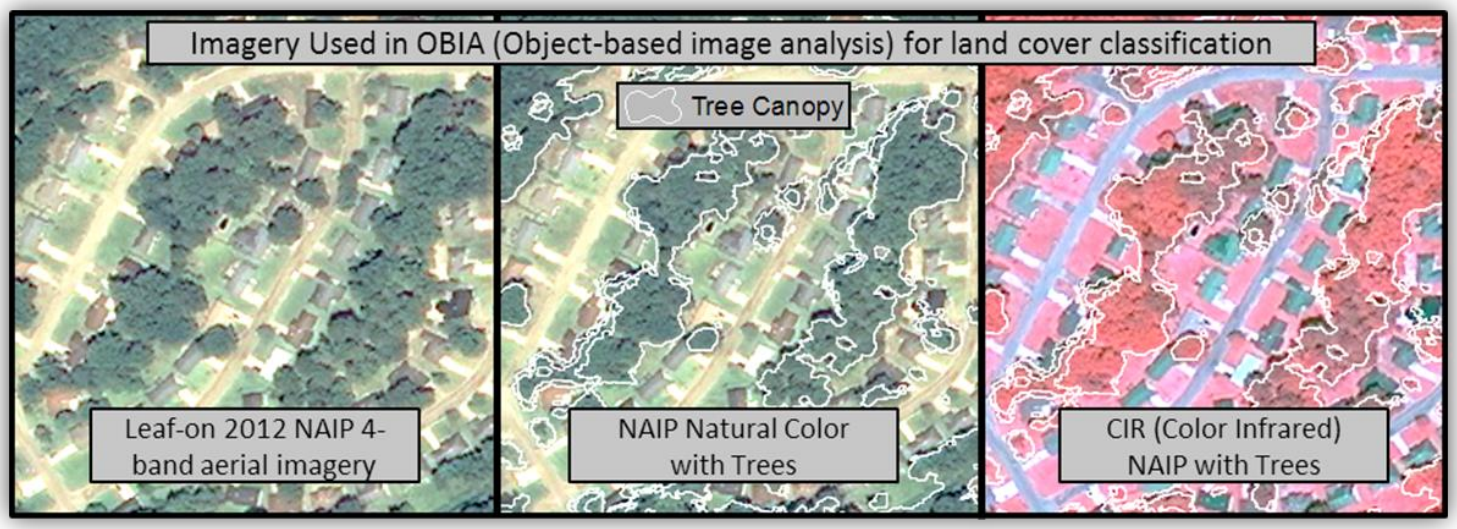


Figure 23: This graphic depicts various imagery used in land cover classification.

Accuracy Assessment

Classification accuracy serves two main purposes: First, accuracy assessments provide information to technicians producing the classification about where processes need to be improved and where they are effective. Secondly, measures of accuracy provide information about how to use the classification and how well land cover classes are expected to estimate actual land cover on the ground. Even with high resolution imagery, very small differences in classification methodology and quality can have a large impact on overall map area estimations. The classification accuracy error matrix illustrated in Table 1 contains confidence intervals that report the high and low values that could be expected for any comparison between the classification data and what actual, on the ground land cover was in 2012.

One thousand (1,000) sample points were randomly distributed across the study area and assigned a random numeric value. Sorting from lowest random value to highest, each sample point was referenced using the NAIP imagery and assigned one of the five land cover classes (Reference ID) mentioned above. Random values ensure sample points are geographically distributed across the entire study area. An automated script is then used to assign values from the classification (Evaluation ID). Misclassified points (where reference ID does not equal evaluation ID) and corresponding land cover are inspected for necessary corrections. The procedure was repeated until an acceptable accuracy percent and classification quality are achieved.

Classification Data	Reference Data: Tree Canopy	Vegetation	Impervious	Soil / Dry Veg.	Water	Total Reference Pixels
Tree Canopy	397	2	13	2	0	414
Vegetation	8	218	3	1	0	230
Impervious	13	7	283	2	1	306
Soil / Dry Veg.	0	5	3	21	0	29
Water	0	0	0	1	17	18
Total	418	232	302	27	18	997

Overall Accuracy = 94%

Producer's Accuracy		User's Accuracy	
Tree Canopy	95%	Tree Canopy	96%
Open Space / Grass	94%	Open Space / Grass	95%
Impervious	94%	Impervious	92%
Bare Ground / Soil	78%	Bare Ground / Soil	72%
Water	94%	Water	94%

Figure 24: Error Matrix Interpretation

Sample Error Matrix Interpretation

Statistical relationships between the reference pixels (representing the true conditions on the ground) and the intersecting classified pixels are used to understand how closely the entire classified map represents the Mississippi landscape. The sample error matrix represents the intersection of reference pixels manually identified by a human observer (columns) and classification category of pixels in the classified image (rows). The white boxes along the diagonals of the matrix represent agreement between the two pixel maps. Off-diagonal values represent the number pixels manually referenced to the column class that were classified as another category in the classification image. Overall accuracy is computed by dividing the total number of correct pixels by the total number of pixels reported in the matrix (397+218+283+21+17 = 936 / 997 = 95%), and the matrix can be used to calculate per class accuracy percent's. For example, 418 points were manually identified in the reference map as Tree Canopy, but only 397 of those pixels were classified as Tree Canopy in the classification map, with 8 pixels misclassified as Vegetation, and 13 as Impervious. This relationship is called the "Producer's Accuracy" and is calculated by dividing the agreement pixel total (diagonal) by the reference pixel total (column total). Therefore, the Producer's Accuracy for Tree Canopy is calculated as: (397 / 418 = 0.95), meaning that we can expect that 95% of all tree canopy in the MS study area were classified as Tree Canopy in the classification map.

Conversely, the "User's Accuracy" is calculated by dividing the number agreement pixel total by the total number of classified pixels in the row category. For example, 397 classification pixels intersecting reference pixels were classified as Tree Canopy, but 2 pixels were identified as Vegetation, 13 as Impervious and 2 as Soil/Dry veg. in the reference map. Therefore, the User's Accuracy for Tree Canopy is calculated as: (397 /414 = 0.96), meaning that pixels classified as Tree Canopy the classification were actual tree canopy in the CONLR. It is important to recognize the Producer's and User's accuracy percent values are based on a sample of the true ground cover, represented by the reference pixels at each sample point.

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