AIR POLLUTION ASSESSMENT AND TREES

EXECUTIVE SUMMARY

August 2022

SAVANNAH TREE
FOUNDATION
Our Trees – Our Future

AIR POLLUTION ASSESSMENT AND TREES

ABSTRACT

In 2022, Savannah Tree Foundation collaborated with Savannah College of Art and Design (SCAD) to enhance Savannah's urban tree canopy equity. Over the course of two quarters, graduate student researchers from a variety of backgrounds worked to address the greatest areas of opportunity and compare tree density, temperature readings and potential impacts thereof in four of Savannah's neighborhoods: specifically, Ardsley Park, Hudson Hill, West Savannah and Woodville.

Through countless hours of on-ground tree surveying, temperature monitoring and studying secondary research, the goal is to collect data to help Savannah Tree Foundation communicate with the public, develop new initiatives and successfully obtain grants through unbiased research.

Image:

Drone footage above Forsyth Park overlooking Savannah's downtown historic district.

About Savannah Tree Foundation

Founded in 1982, Savannah Tree Foundation protects and grows Chatham County's urban forest through tree planting, community engagement, and advocacy.

Trees are one of Chatham County's most treasured natural resources. Beyond their beauty and cultural significance, the impacts of trees are far-reaching and compounding, spanning from economic benefits to health improvements to climate change resilience. Trees are woven into almost every aspect of our lives.

Savannah Tree Foundation has coordinated the planting of over 5,000 trees in Chatham County.

While it is easy to take our live oaks and magnolias for granted, our trees are facing an increasing number of natural and man-made threats. Sprawling construction, increased severe weather, encroaching salt water levels, and a lack of funding for proper maintenance all contribute to tree loss in our region. If we are to continue enjoying the beauty and benefits of our trees, we must protect the trees we have and plant the trees of tomorrow. Properly cared for, our urban forest will create a safer and healthier community. Our trees will shape our future. For more information, visit **savannahtree.org**.

Image (Left): Savannah Tree Foundation founders Susie Williams, Linda Beam and Page Hungerpiller, 1978.

MISSION

Savannah Tree Foundation protects and preserves Chatham County's urban forest through tree planting, community engagement, and advocacy.

VISION

To inspire and educate our community to create and sustain a healthy urban forest today, tomorrow, and forever.

> "America's urban forests are critical capital investments helping produce clear air and water; reduce energy costs; and, making cities more livable.
>
> SIMPLY PUT, OUR URBAN FORESTS IMPROVE PEOPLE'S LIVES."
>
> —Michael T. Rains, Director of the Forest Service's Northern Research Station and Acting Director of the Forest Products Lab.

Introduction

AIR POLLUTION ASSESSMENT AND TREES

Air pollution and the accompanying negative health and climate effects are widely documented in the US. The research in this whitepaper aims to illuminate the disparities between neighborhoods in Savannah and illustrate the health, economic, criminal and pollution reduction outcomes in those same neighborhoods. This data allows us to draw attention to the declining health and safety of those neighborhoods suffering from greater air pollution due to lesser tree canopies and a higher prevalence of the urban heat island effect.

Key Insights

TREE COVERAGE BENEFITS

While sometimes overlooked, tree coverage benefits are directly and indirectly related to health, stress and crime.

Communities with less tree coverage suffer from higher occurrences of health issues due to a lack of trees available for pollution absorption.

Communities with greater tree coverage enjoy better health, lower stress levels and even a reduction in crime.

(US Forest Service)

ABSORPTION OF CARBON DIOXIDE

Trees are major contributors to absorption of carbon dioxide, resulting in cleaner air quality.

Over one year, a mature tree will absorb more than 48 pounds of carbon dioxide (CO2) from the atmosphere and release oxygen in exchange. One large tree can provide a day's supply of oxygen for up to four people. (US forest Service)

Large healthy trees greater than 77 cm in diameter remove approximately 70 times more air pollution annually (1.4 kg/yr) than small healthy trees less than 8 cm in diameter (0.02 kg/yr).

(USDA Forest Service)
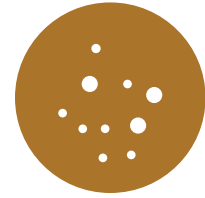
URBAN FORESTS SAVE LIVES

Urban forests absorb fine particulate pollution and help in reducing deaths, pulmonary inflammation and other serious health effects.

Urban trees and forests are saving an average of one life every year per city by absorbing the concentrations of fine particulate pollution (particulate matter less than 2.5 microns, or PM2.5) in the air.

Early death due to exposure to fine particles is the greatest risk posed by the removal of urban forests. Fine particulate air pollution also has other serious health effects, including premature mortality, pulmonary inflammation, accelerated atherosclerosis, and altered cardiac functions.

(US Forest Service)

POLLUTION REMOVAL RATES

Pollution removal rates provide an estimated monetary value to society.

In 1994, trees in New York City removed an estimated 1,821 metric tons of air pollution at an estimated value to society of $9.5 million.

Standardized pollution removal rates differ among cities according to the amount of air pollution, length of in-leaf season, precipitation, and other meteorological variables.

Further studies specific to Savannah can help correlate pollution removal and a value to society.

(USDA Forest Service)

HEALTH & ECONOMIC IMPACTS

Air pollution leads to health and economic impacts that are detrimental in costs and damages related to workforce and industry output.

Air pollution negatively impacts the U.S. economy, costing the U.S. roughly 5 percent of its yearly gross domestic product (GDP) in damages ($790 billion in 2014).

The highest costs come from early deaths, attributable to exposure to fine particulate matter, followed by sick days, medical bills and reduced agricultural output.

(Stanford University)
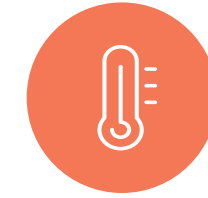
URBAN FOREST PLANNING

Investing in the future of urban forests will improve neighborhoods and save lives.

Every dollar spent on planting and caring for a community tree yields benefits that are two to five times that investment—benefits that include cleaner air, lower energy costs, improved water quality and storm water control and increased property values.

(US Forest Service)

Who Does This Impact?

This research is based on four neighborhoods located in Savannah, Georgia. Here is an overview of the history of the neighborhoods included: Ardsley Park, Hudson Hill, West Savannah and Woodville.

The area that became Hudson Hill, West Savannah and Woodville originally belonged to the Yamacraw. In 1757, the lands were handed over to the crown who then distributed them to colonists. It then became the Royal Valley Plantation.

People settled in the area during the early 20th century, and residential development happened in the late nineteenth century.

Work was the magnet that brought families into West Savannah, Hudson Hill and Woodville, primarily through the railroad. However, this began to decrease by the 1970s, and crumbled in the 1990s.

The Ardsley Park neighborhood is the result of two planned subdivisions that were laid out in 1909 and 1910. This was a time of great growth and prosperity in Savannah and substantial houses of the neighborhood reflect this affluence.
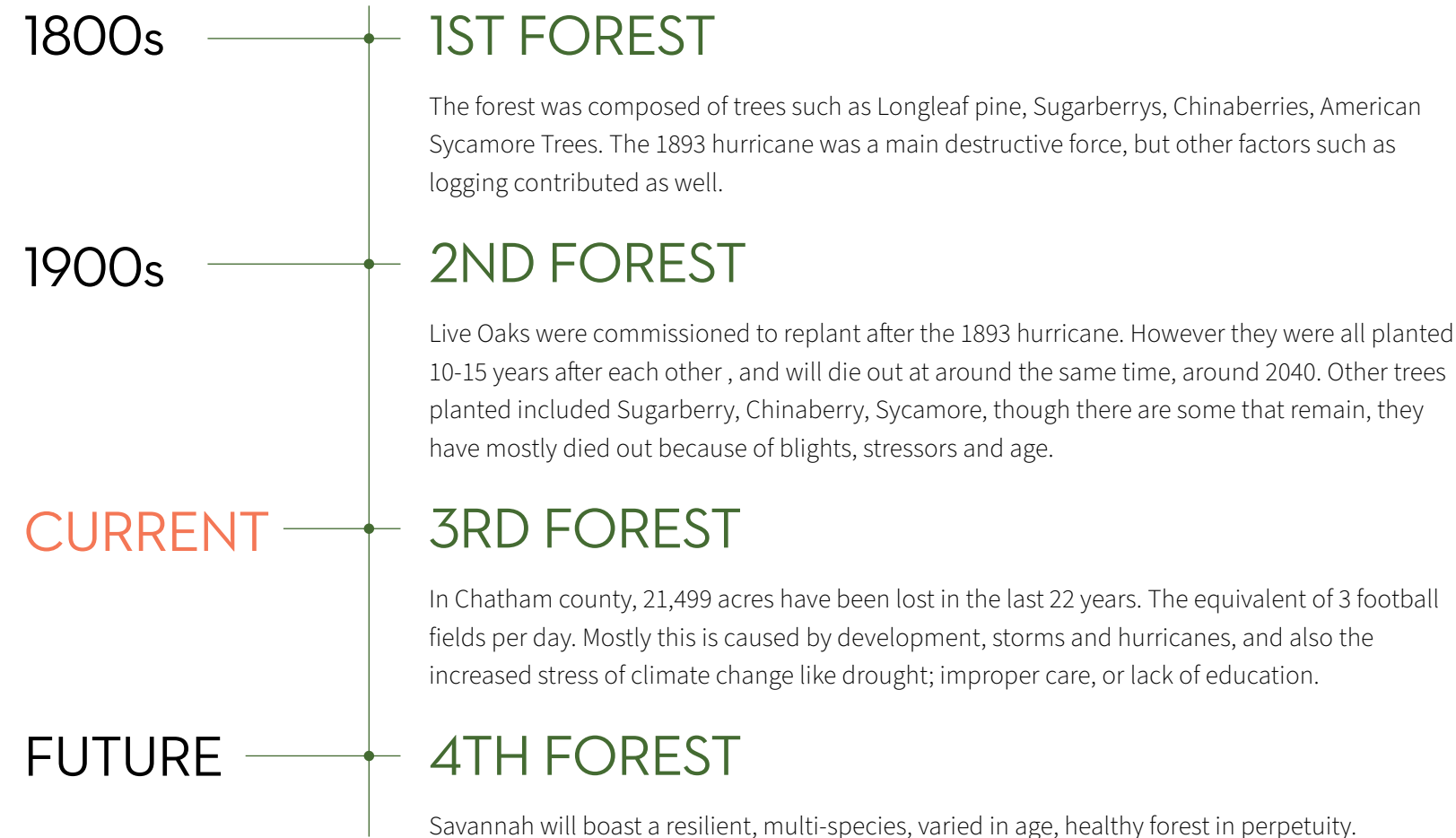
The developers of Ardsley Park, Savannah-natives Harry Hays Lattimore and William Lattimore, laid out the neighborhood according to a strict grid with one-acre landscaped parks placed in regular intervals and offset along the north-south corridor of Abercorn Street.

Sources: *Low Land and the High Road: Life and community in Hudson Hill, West Savannah, and Woodville Neighborhoods*, **Public Library of Savannah's historical records and Historic Savannah Foundation.**

ARDSLEY PARK

Residents
3,338

Average Income
$81,224

Demographics
84% White
12.4% Asian & other
2.9% Black

WEST SAVANNAH

Residents
3,653

Average Income
$22,578

Demographics
54.6% Black
28% White
16.5% Asian & other

HUDSON HILL

Residents
2,320

Average Income
$22,578

Demographics
78.4% Black
12% Asian & other
9.5% White

WOODVILLE

Residents
460

Average Income
$39,333

Demographics
52.9% Black
26.6% Asian & other
21.5% White

Source: point2homes.com and city-data.com

History of Savannah's Urban Forest

1800s — **1ST FOREST**

The forest was composed of trees such as Longleaf pine, Sugarberrys, Chinaberries, American Sycamore Trees. The 1893 hurricane was a main destructive force, but other factors such as logging contributed as well.

1900s — **2ND FOREST**

Live Oaks were commissioned to replant after the 1893 hurricane. However they were all planted 10-15 years after each other , and will die out at around the same time, around 2040. Other trees planted included Sugarberry, Chinaberry, Sycamore, though there are some that remain, they have mostly died out because of blights, stressors and age.

CURRENT — **3RD FOREST**

In Chatham county, 21,499 acres have been lost in the last 22 years. The equivalent of 3 football fields per day. Mostly this is caused by development, storms and hurricanes, and also the increased stress of climate change like drought; improper care, or lack of education.

FUTURE — **4TH FOREST**

Savannah will boast a resilient, multi-species, varied in age, healthy forest in perpetuity.

CO2 Comparison by Lot

1.3 Trees per Lot (Residential Area)

48 lb CO2 Absorbed (Per Year)

W. SAVANNAH

9.3 Trees per Lot (Residential Area)

432 lb CO2 Absorbed (Per Year)

ARDSLEY PARK

2.9 Trees per Lot (Residential Area)

96 lb CO2 Absorbed (Per Year)

HUDSON HILL

4.1 Trees per Lot (Residential Area)

192 lb CO2 Absorbed (Per Year)

WOODVILLE

The above graphics depict our four focus neighborhoods, with the average lot sizes, house sizes and tree coverage by neighborhood. Based on the average tree count per lot, the estimated CO2 absorption is calculated.
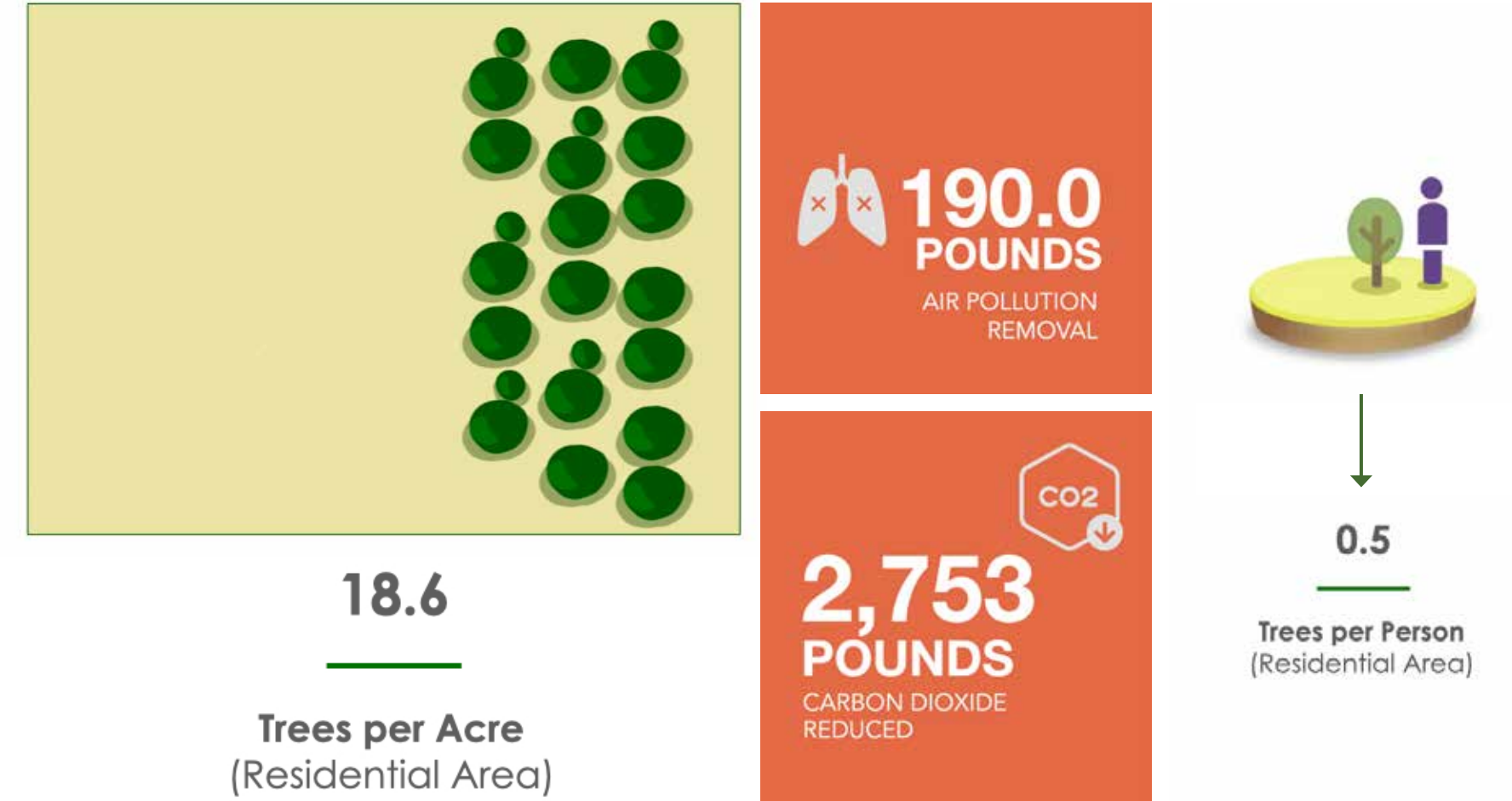
Trees Per Acre and Tree Benefits Over 10 Years*

ARDSLEY PARK

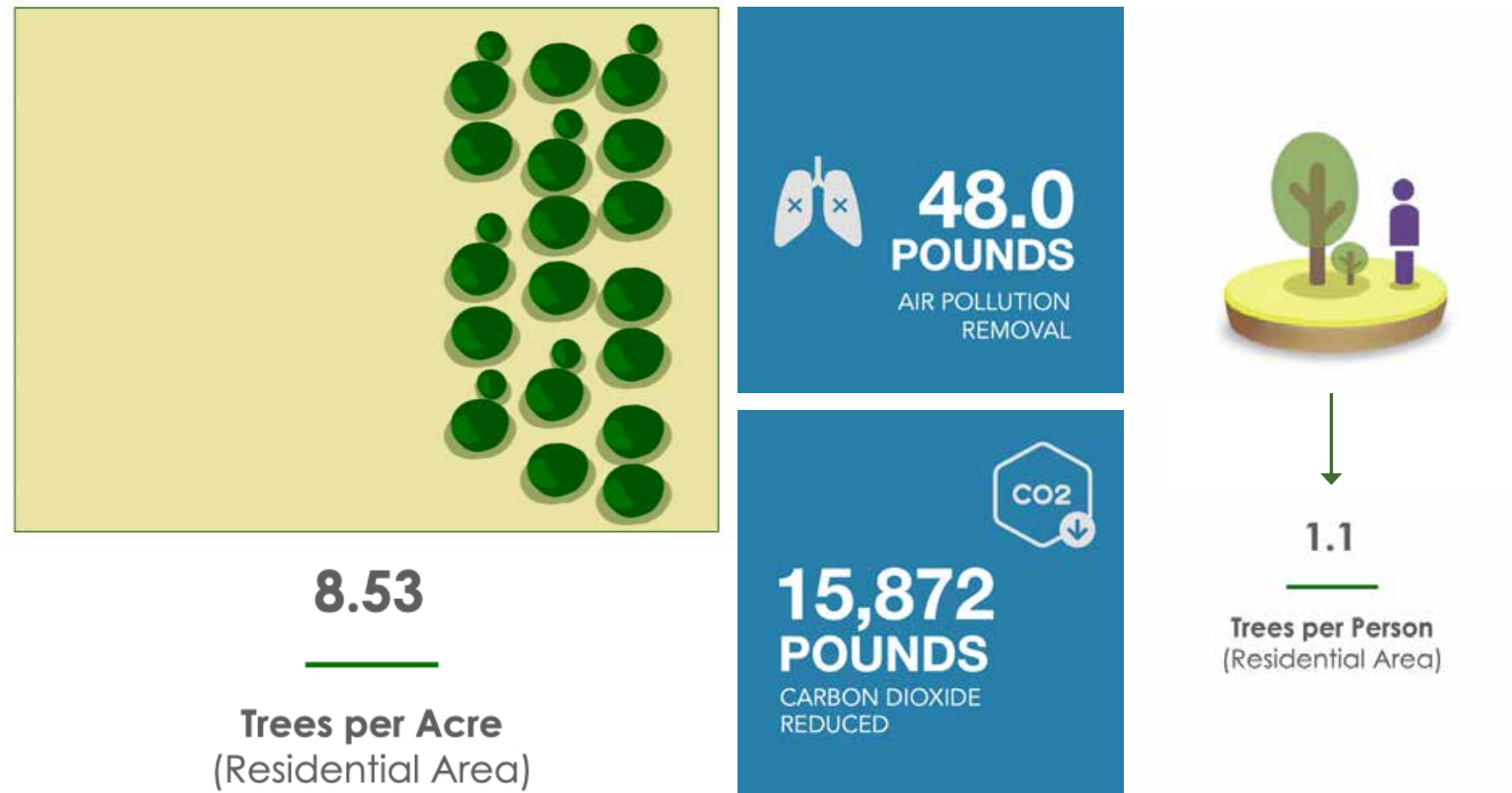**38.2**

Trees per Acre
(Residential Area)

190.0 **POUNDS**
AIR POLLUTION REMOVAL

55,102 **POUNDS**
CARBON DIOXIDE REDUCED

3.8

Trees per Person
(Residential Area)

WEST SAVANNAH

18.6

Trees per Acre
(Residential Area)

190.0 **POUNDS**
AIR POLLUTION REMOVAL

2,753 **POUNDS**
CARBON DIOXIDE REDUCED

0.5

Trees per Person
(Residential Area)

*Average Tree Density across the neighborhoods is extrapolated from the average number of healthy trees per acre of residential land. Fact comparisons based on potential benefits from trees per average lot across the neighborhoods. Figures are extrapolated from itree canopy. Average benefit per lot is calculated over 10 years.
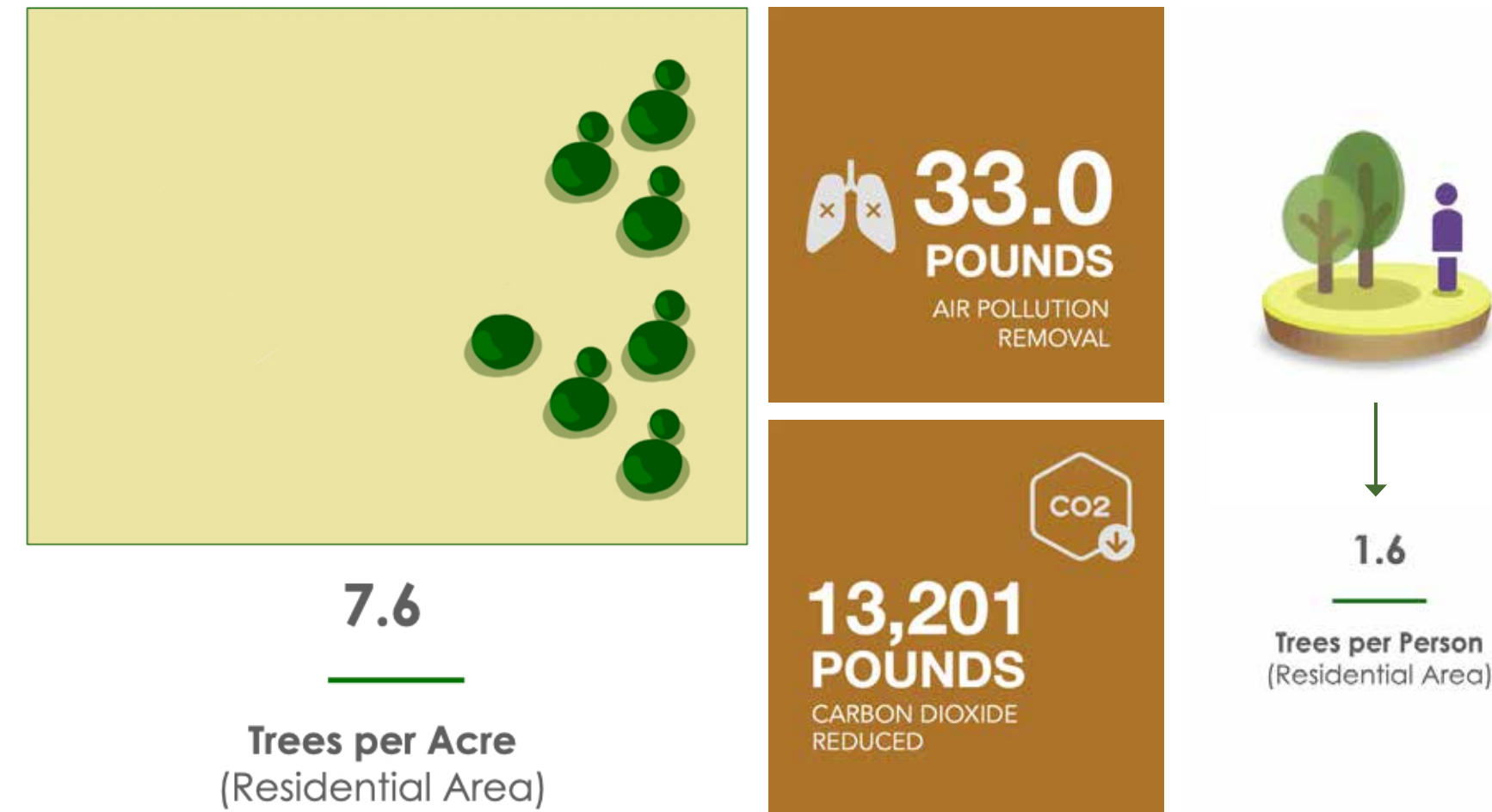
Trees Per Acre and Tree Benefits Over 10 Years[*]

HUDSON HILL

8.53

Trees per Acre
(Residential Area)

48.0 POUNDS
AIR POLLUTION REMOVAL

15,872 POUNDS
CARBON DIOXIDE REDUCED

1.1

Trees per Person
(Residential Area)

WOODVILLE

7.6

Trees per Acre
(Residential Area)

33.0 POUNDS
AIR POLLUTION REMOVAL

13,201 POUNDS
CARBON DIOXIDE REDUCED

1.6

Trees per Person
(Residential Area)

*Average Tree Density across the neighborhoods is extrapolated from the average number of healthy trees per acre of residential land. Fact comparisons based on potential benefits from trees per average lot across the neighborhoods. Figures are extrapolated from itree canopy. Average benefit per lot is calculated over 10 years.

Tree Impact Example: Candler Oak

AS THE OLDEST TREE IN SAVANNAH, THE CANDLER OAK SITS JUST OFF FORSYTH PARK AND ITS REIN SPANS THE HISTORY OF THE CITY. At the time it took root, it was situated on a beautiful wooded bluff bordering a river. For over 300 years, this city landmark has provided shade on the hottest days to those who needed it most while making the area healthier for its residents and guests. Trees like this and the other most populous trees across the city, help to combat increasing climate issues by sequestering carbon, emitting oxygen and assisting with storm water mitigation.

Although the Candler Oak is renowned for its age and size, both which directly contribute to carbon sequestration, trees provide the most benefit when diverse species are planted with purpose in order to address the needs of the community. Savannah, in particular, benefits greatly from its popular Eastern Red Cedar, Tupelo, Longleaf Pine and Bald Cypress trees which are drought tolerant and love areas prone to flooding. The Tupelo also has the added benefit of supporting the declining bee population.

While the large trees are always popular for shade and beauty, it is also important to nurture the existing smaller tree populations such as the Souther Catalpa and the Two-Wing Silverbell which are needed to help replace the aging Crape Myrtle trees throughout the county.
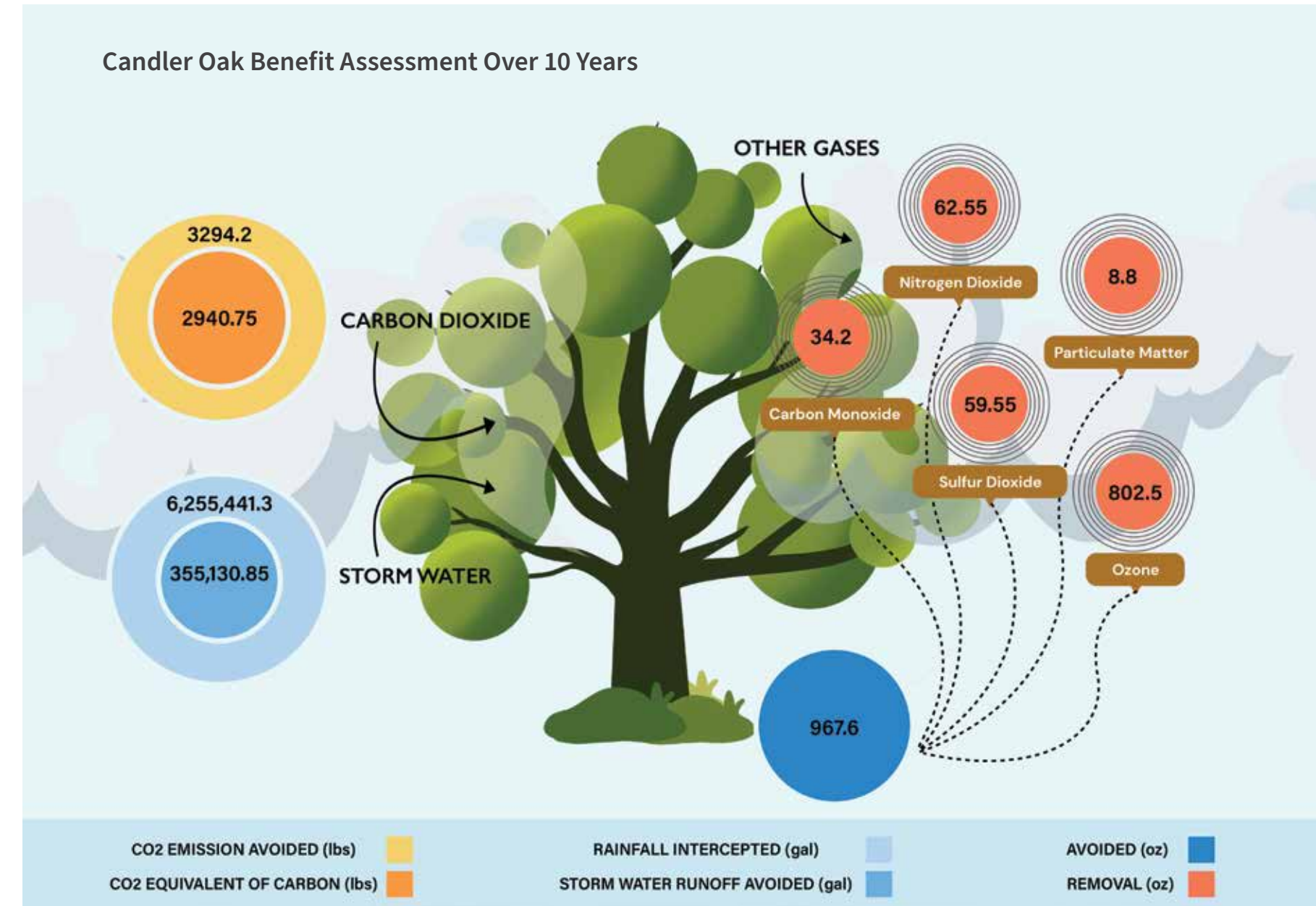
The benefits of these and other appropriate trees are reflected in the Candler Oak and all that this living organism has given the city of Savannah throughout its storied history.

Candler Oak, 1870

Candler Oak, Currently

Candler Oak Benefit Assessment Over 10 Years

CARBON DIOXIDE
3294.2
2940.75

STORM WATER
6,255,441.3
355,130.85

967.6

OTHER GASES

Nitrogen Dioxide — 62.55
Particulate Matter — 8.8
Carbon Monoxide — 34.2
Sulfur Dioxide — 59.55
Ozone — 802.5

- CO2 EMISSION AVOIDED (lbs)
- CO2 EQUIVALENT OF CARBON (lbs)
- RAINFALL INTERCEPTED (gal)
- STORM WATER RUNOFF AVOIDED (gal)
- AVOIDED (oz)
- REMOVAL (oz)

Health Impacts of Air Pollution

RESPIRATORY

- Wheezing and coughing
- Shortness of breath
- Asthma attacks
- Worsening COPD
- Lung cancer

OTHER

- Premature death
- Susceptibility to infections
- Heart attacks and strokes
- Impaired cognitive functioning
- Metabolic disorders
- Pre-term births and low birth weight

Source: American Lung Association 2022 State of Air Report

Health Impacts of Exposure to Extreme Heat

Indirect Impacts

Impact on Health Services
- Increased Ambulance Call-Outs and Slower
- Response Times
- Increased Number of Hospital Admissions
- Heat Cramps
- Storage of Medicines

Increased Risk of Accidents
- Drowning
- Work-related Accidents
- Injuries and Poisonings

Increased Transmission
- Food and Waterborne Diseases
- Marine Algal Blooms

Potential Disruption of Infrastructure
- Power
- Water
- Transport
- Productivity

Direct Impacts

Heat Illness
- Dehydration
- Heat Cramps
- Heat Stroke

Accelerated Death from
- Respiratory Disease
- Cardiovascular Disease
- Other Chronic Disease (mental health, renal disease)

Hospitalization
- Respiratory Disease
- Diabetes Mellitus
- Renal Disease
- Stroke
- Mental Health Conditions

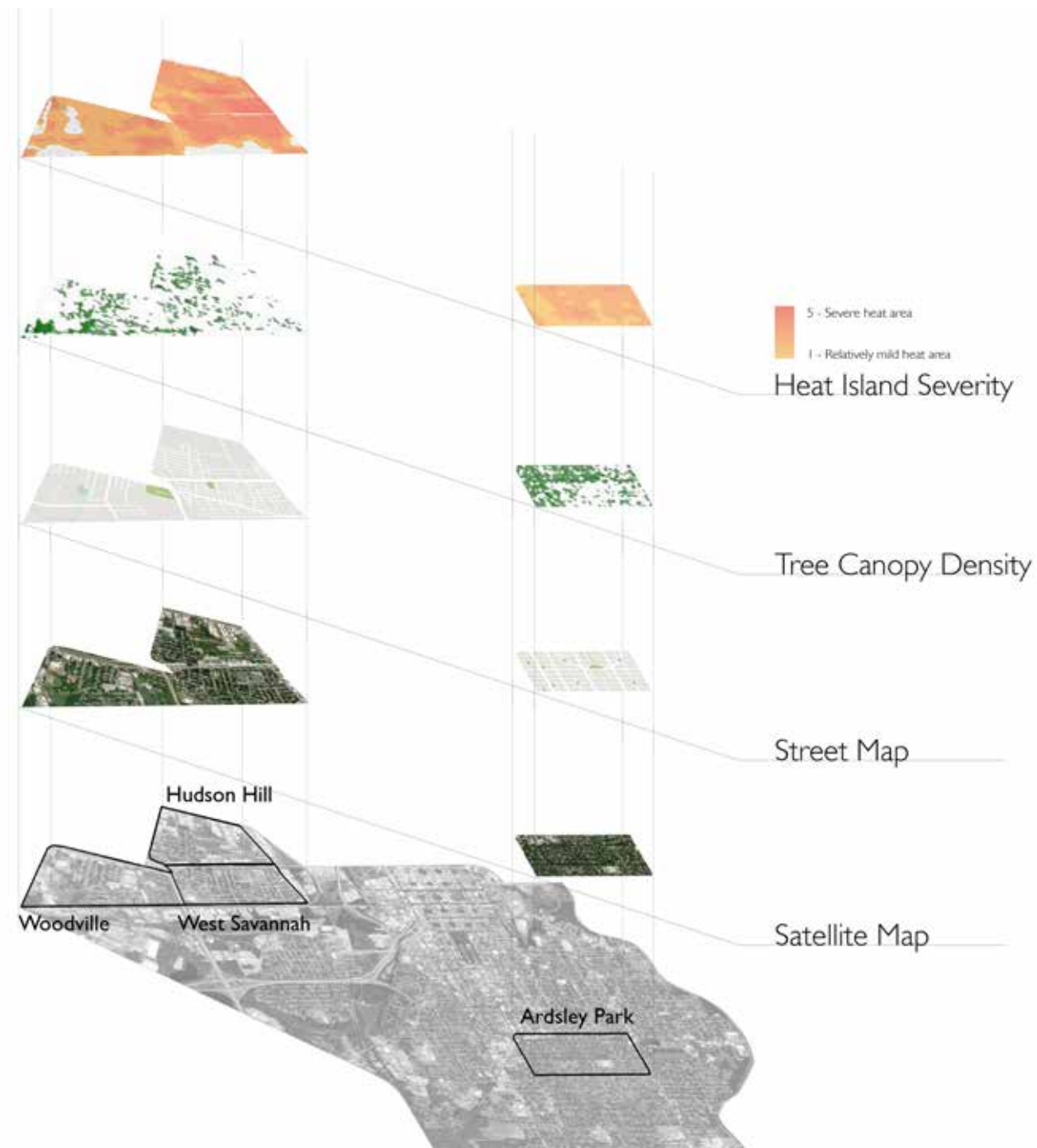**Source: World Health Organization**

Heat Stack Map

The map depicts the location of all 4 neighborhoods, Ardsley Park, West Savannah, Hudson Hill and Woodville, in relation to each other. The layers of maps including satellite map, street map, tree canopy density, heat island severity and flood hazard level. Comparing to Ardsley Park, the other 3 neighborhoods, with less tree canopy density, have higher heat island level and face more risk of flood hazard.

Source: arcgis.com

5 - Severe heat area
1 - Relatively mild heat area
Heat Island Severity

Tree Canopy Density

Street Map

Satellite Map

Hudson Hill

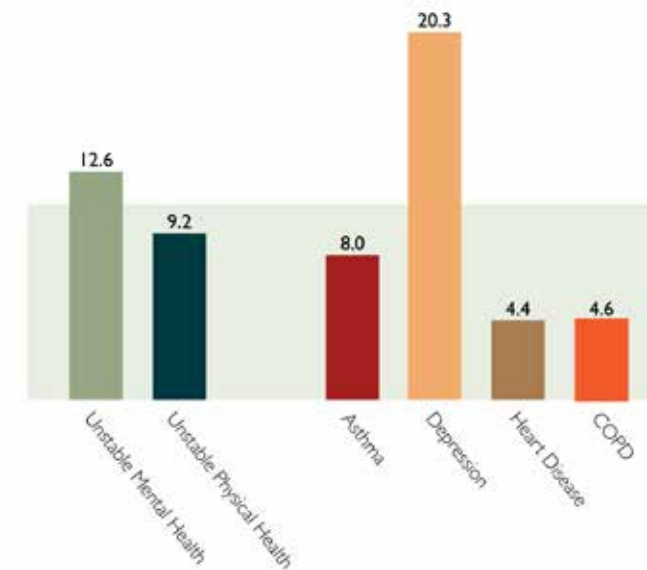Woodville   West Savannah

Ardsley Park
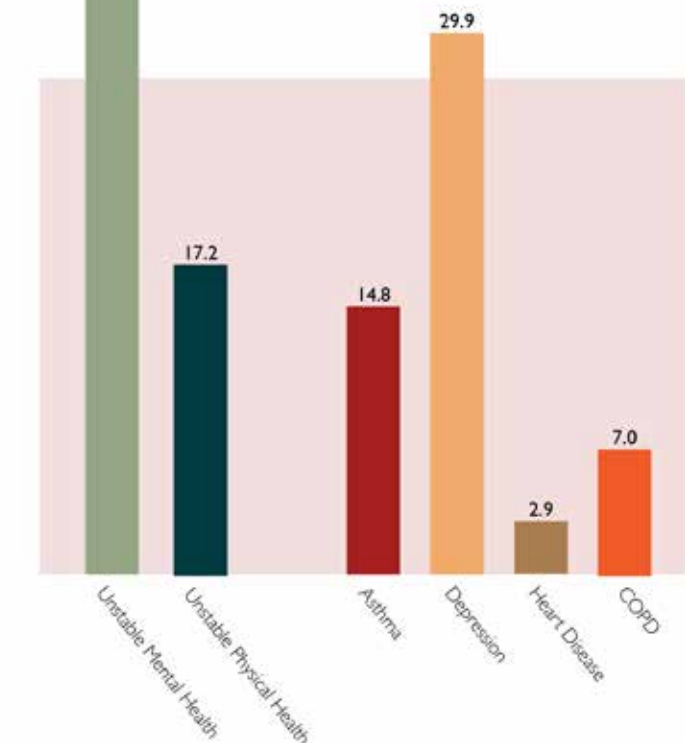
Health Comparison

ARDSLEY PARK
10.8%
Poor General Health

WEST SAVANNAH
27.4%
Poor General Health

The chart compares the average percentage of health conditions including mental health, physical health and 4 major diseases of Ardsley Park and West Savannah. West Savannah has a much higher average prevalence of most health conditions.

Neighborhood Health Statistics

ARDSLEY PARK

Population **2,986**	Mental health **12.6%**
General health **10.8%**	Physical health **9.2%**

WEST SAVANNAH

Population **1,811**	Mental health **36%**
General health **27.4%**	Physical health **17.2%**

The data above is based on Center for Disease Control statistics from a study documenting the annual prevalence from years 2011-2015 of the above health statuses. The percentages indicate the number of people experiencing poor health outcomes in 14 out of the previous 30 days.

Conclusions

The well-documented and severe impact across all aspects of human wellbeing from air pollution cannot be ignored. While there are larger considerations and policies needed in order to address the widespread causes of air pollution, there are still things that communities can do to help offset these effects. Planting the right tress and maintaining them properly is one of the best defenses against air pollution that individuals can invest in. In Savannah alone, there is a wide disparity between upper-and lower-income neighborhoods and the amount of tree coverage that they enjoy. As a result of that disparity, there are legitimate and serious consequences that are playing out in real time. Decreased overall health, increased costs and a community breakdown are only a few of the impacts that have been verified.

A plan to balance the inequitable tree distribution, and accompanying negative health effects, across Savannah neighborhoods is urgently needed.

Methodology

1. Survey the tree canopy, temperatures and impervious surface data in the neighborhoods of Ardsley Park, West Savannah, Woodville and Hudson Hill.

2. Conduct and compile ethnographic data (surveys, interviews and conversations).

3. Compile secondary research related to the impact Urban Heat Islands (UHI), including quality of life, health, mental health, livability and other factors.

4. Visualize data in reports through infographics.

5. Share these findings with Savannah Tree Foundation and government partners, community leaders, local businesses and SCAD to build collaborative capacity for a comprehensive and equitable Savannah tree management plan.

Terms

Urban forest: all trees within a densely populated area, including trees in parks, on streetways, and on private property

Urban Heat Island: this occurs when cities replace natural land cover with dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat.

About SCADServe

The multidisciplinary course, GOOD 560 Design for Good, directly supports the mission of SCAD SERVE, our community service design studio. Focusing on four critical areas of need — food, clothing, shelter, and environment — SCAD SERVE empowers the SCAD community to listen to the needs of its neighbors and local leaders, and create meaningful design solutions that improve quality of life.

Volunteerism, public service, and social impact are and always have been an integral part of SCAD's character. GOOD 560 Design for Good employs our students' collective brilliance through elevated, design-for-good solutions that make a difference in our hometowns of Atlanta and Savannah. For more information, visit **scad.galaxydigital.com**.

Images (Right):

Summer and Spring GOOD 560 class members (listed below).

Lia Alemán, Design for Sustainability M.F.A. • Sofia Alturas, Design for Sustainability M.A.Shreyas • Athreya, Design for Sustainability M.F.A. • Lindsay Brine, Service Design M.F.A. • María Carrau, Architecture M.A. • Kiera Ceyssens, Design for Sustainability M.F.A. • Ankit Charturvedi, Design for Sustainability M.F.A. • Yushan Chen, Service Design M.F.A. • Emma Covello, Design for Sustainability M.F.A. • Amber Francis, Service Design M.A. • Tanvi Gudipudi, Design for Sustainability M.F.A. • Vivek Gupta, Design for Sustainability M.A. and Jewelry M.A. • Seth Holland, Design for Sustainability M.F.A. • Olivia Loeffler, Design for Sustainability M.F.A • Anirbaan Mukherjee, Design for Sustainability M.F.A. • Kanchi Parekh, Design Management M.A. • Morgan Rizzo, Design for Sustainability M.A. • Daniela Rodriguez, Design for Sustainability M.A. • Riley Shelton, Design for Sustainability M.F.A. • Olivia Snow, Design for Sustainability M.F.A. • Brittany Snyder, Design for Sustainability M.F.A. • Harshini Vasu, Design for Sustainability M.F.A. • Professor Scott Boylston, Graduate Coordinator, Design for Sustainability Program • Professor Saty Sharma, Design for Sustainability Program

MISSION

To enhance Savannah Tree Foundation's efforts in ensuring tree canopy equity through gathering and synthesizing data, experiences, and community relationships.

SAVANNAH TREE FOUNDATION
OUR TREES · OUR FUTURE

Published in conjunction with SCADServe