

# Tree Canopy Coverage & Change Detection

City of Brookhaven, Georgia | 2010 – 2015  
*Final Results*



*2015 Natural Color (left) and Infrared Color (right) Imagery of Peachtree Road and Dresden Drive in Brookhaven, Georgia*

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# Tree Canopy Coverage & Change Detection: Brookhaven, Georgia 2016 Report

## Overview and Background

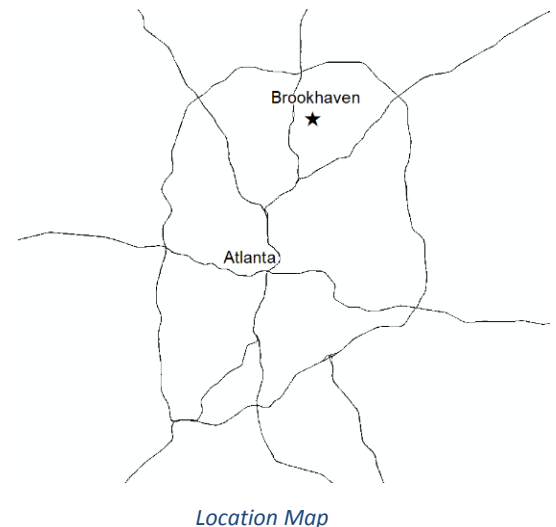
The City of Brookhaven, Georgia commissioned a study of the urban tree canopy. The purpose of the study is to assist the City by providing key decision makers and citizens a quantitative method for monitoring tree canopies. Performing this study over the course of several years is a powerful tool for understanding and monitoring important trends in your tree canopy.

In 2014, the City of Brookhaven started the process of revising the City's tree ordinance. The Community Development Director, City Arborist, and InterDev GIS proactively developed an innovative method to accurately measure the City's tree canopy. The study's final results showed the canopy coverage for 2010 (51.7%) and 2013 (49.0 %.) More importantly this study established a baseline measurement for monitoring Brookhaven's tree canopy into the future.

Using satellite imagery obtained through U.S. Department of Agriculture's National Agricultural Imagery Program (NAIP), this study performs a series of analyses using advanced GIS tools and processes to extract the tree canopy within the city limits. The NAIP imagery program was developed by the U.S. Department of Agriculture to provide satellite imagery during the "leaf-on" season that is used for a variety of different applications, mostly in the farming, agricultural, or timber industries. This study uses this imagery in the urban setting to help calculate Brookhaven's tree canopy.

This study does not aim to highlight the numerous important factors of maintaining the tree canopy nor does this study aim to provide recommendations for changes to ordinances or policies that are used for tree preservation and replacement. This analysis aims to provide the city with a measurement of tree canopy for each square meter of the City and overall percent coverage.

During the past 3 years, Brookhaven has seen unprecedented development which caused citizens to have legitimate concerns over the valuable tree canopy. By commissioning this study, Brookhaven will continue to develop an authoritative method to continuously monitor the change in tree canopy. Our hope is that this information will facilitate informed and educated conversations around preserving Brookhaven's valuable tree canopy.



## Findings

The following table is an overview of our findings:

Percent Coverage of Canopy	2010	2013	2015
Total City-Wide	51.7%	49.0%	53.6%
Consolidated Zoning Category			
Single Family Residential Areas	61.8%	59.6%	60.7%
Multifamily Residential Areas	42.7%	46.7%	49.7%
Commercial/Industrial Areas	37.3%	37.7%	38.8%

Final results show a small gain in total tree canopy over the past 5 years.

For the purpose of this study, our goal was to measure the City's canopy by total area and smaller areas of consolidated zoning categories. This allows decision makers to further dive deeper into the results and explore in finer detail where canopy was either lost or gained.

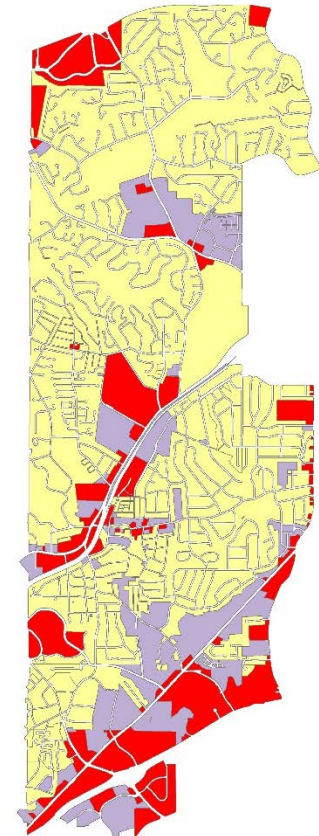
The City's zoning districts were consolidated into 3 reporting areas: single family residential, multifamily residential and commercial/industrial. The areas highlighted in yellow are identified as single family residential, the areas highlighted in purple are multiple family residential, and the areas highlighted in red are identified as commercial or industrial (see map on right).

Although our findings have identified several localized areas of major canopy loss of 5 acres or more (see maps on pages 6 and 7), overall the City's tree canopy was relatively unchanged or slightly increased.

Based on our analysis, the City has an estimated 3,928 acres of tree canopy out of a total of 7,420 acres. Studies such as this and others have indicated that over the course of a few years the slow, normal growth of a tree canopy of this size has been enough to offset the rate of trees being lost on single lots and a few large developments.

Age, condition, and the environmental factors associated with urban forest management is an extremely important factor and should be considered when using this data to analyze the health of your urban forest. Determining and analyzing these factors are outside the scope of this study.

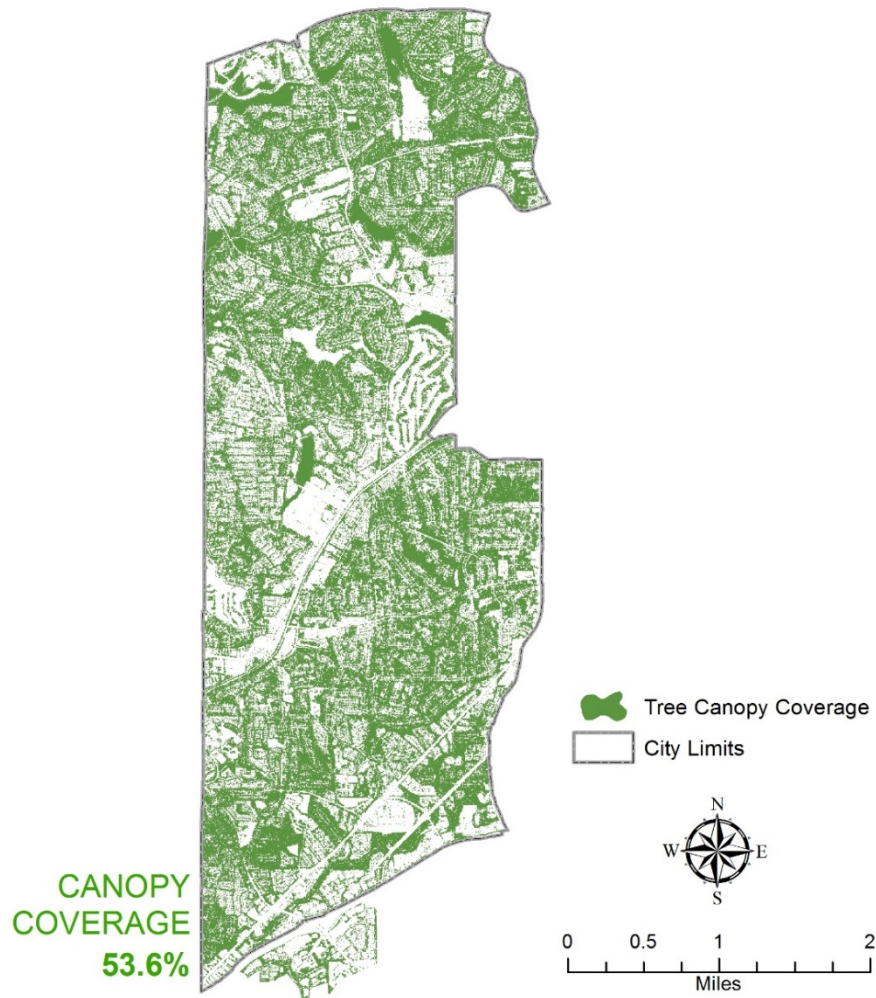
The following pages contain a series of maps identifying tree canopy coverage and tree canopy change between the years of 2010 and 2015.



**Consolidated Zoning Categories**

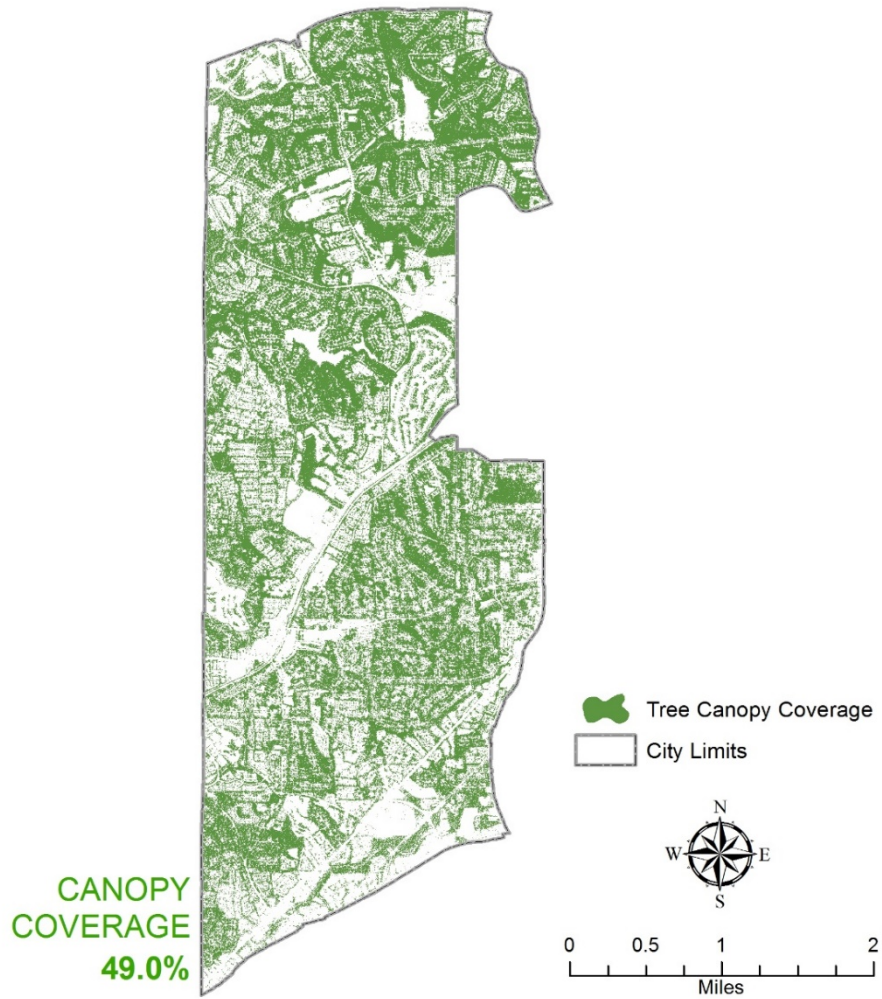
- Commercial/Industrial
- Multifamily Residential
- Single Family Residential

## 2015 Tree Canopy Coverage



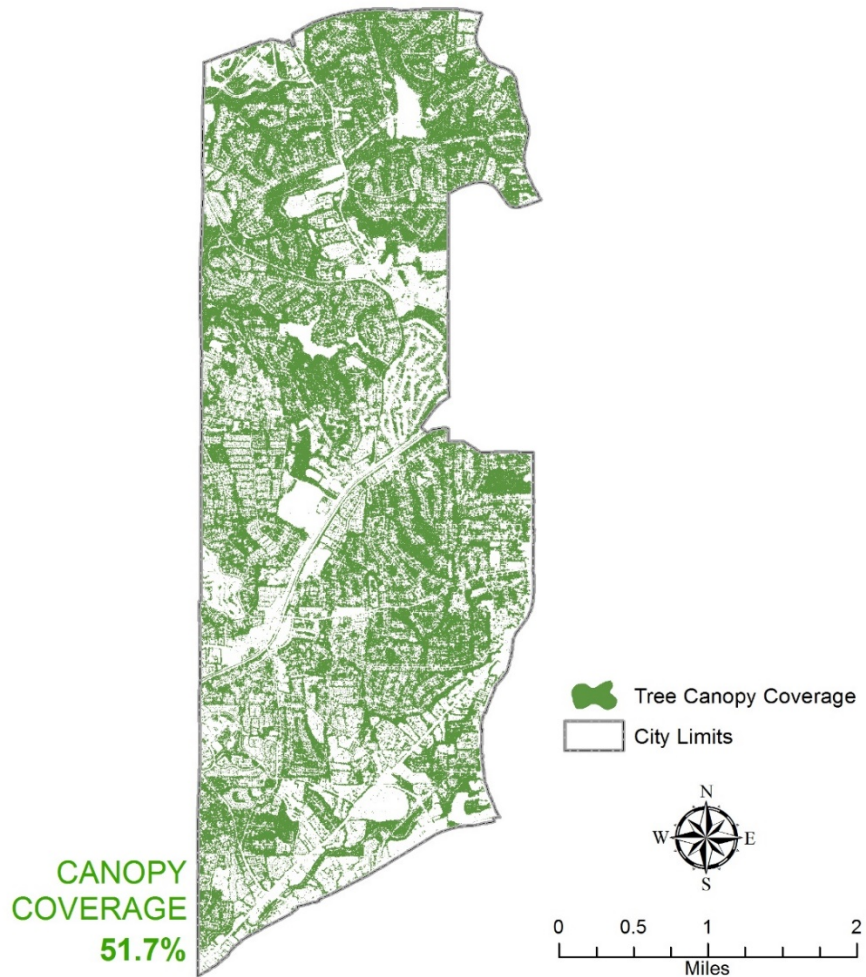
City of Brookhaven, Georgia

## 2013 Tree Canopy Coverage

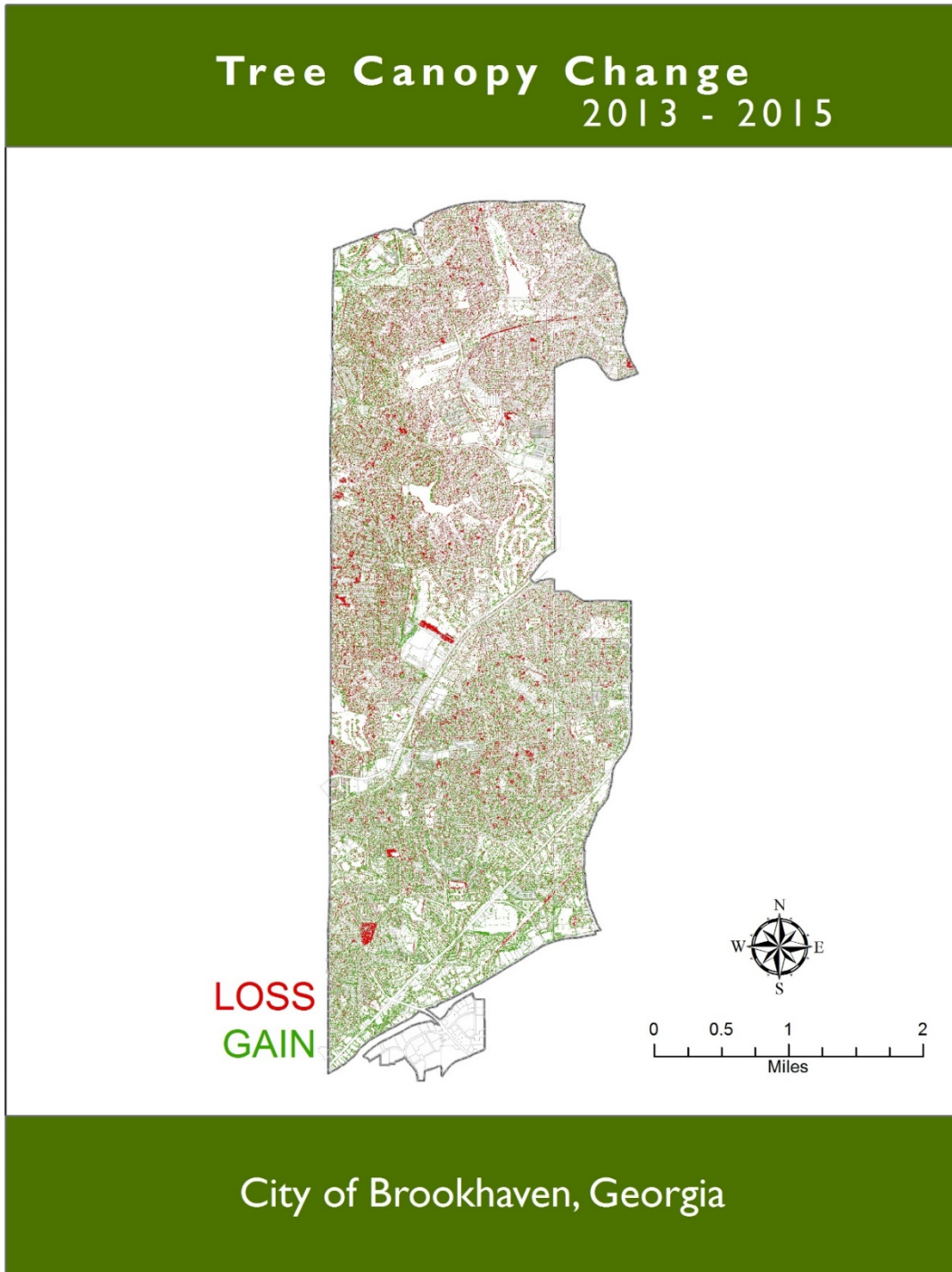


City of Brookhaven, Georgia

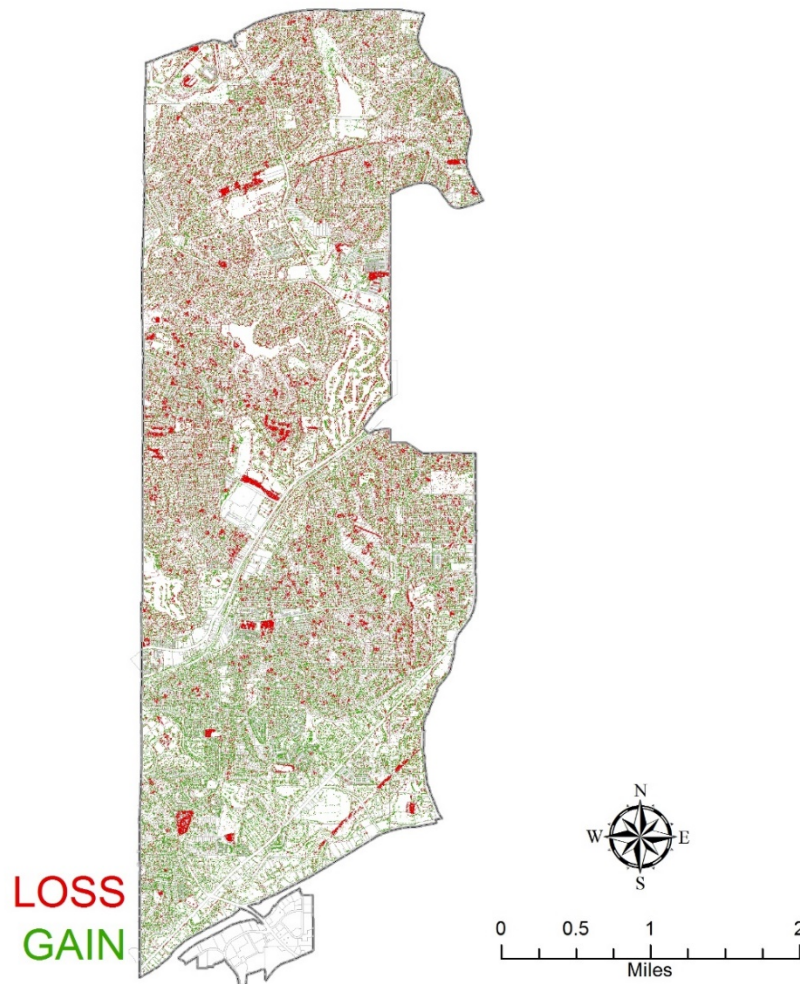
## 2010 Tree Canopy Coverage



City of Brookhaven, Georgia



## Tree Canopy Change 2010 - 2015



City of Brookhaven, Georgia



## Methodology

Aerial imagery collected in 2010, 2013 and 2015 is analyzed to measure the canopy coverage and change over time.

## Imagery

Imagery was obtained through the U.S. Department of Agriculture National Agricultural Imagery Program (USDA NAIP). The NAIP imagery program provides 1-meter resolution aerial imagery collected during the “leaf-on” season on a 3-5-year cycle.

NAIP imagery is important because it attempts to produce near identical conditions in imagery collection over the span of 3-5 years. A critical factor in the determination of tree canopy coverage over time is the ability to compare two aerial imagery data sets taken years apart that are as close to identical as possible. Identical conditions include variables such as time of day, time of year, pixel size, camera angle, and cloud cover as well as other variables.

Below is side-by-side aerial imagery showing tennis courts and a swimming pool in 2009 and 2015. Imagery on the left was collected in July 2009. Imagery on the right was collected in July 2015. Notice the shadows over the pool and tennis courts, they are almost in the same location indicating these 2 aerial photos were taken at approximately the same time of day but 6 years apart.



*2009 NAIP Imagery*



*2015 NAIP Imagery*

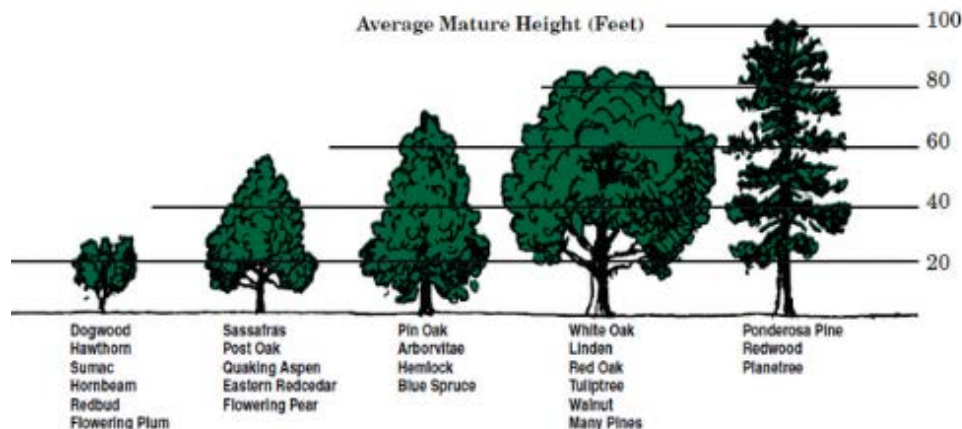
## Analysis

The processing technique used in this study is called the *Iso Cluster Unsupervised Classification* tool. This process analyzes each pixel in the image to find natural clusters of values (or colors.) It then programmatically combines millions of pixels values down to 100 different values based on similar pixel value characteristics. In essence it automatically simplifies the colors of the image.

Once all the pixel values are combined into 100 manageable values, our analyst reviews each of the 100 values and classifies them as *Canopy*, *Non-Canopy*, or *Unknown*. Basically, we are training the database: “We’ve identified this pixel as being a tree canopy, now go ahead and identify all similar pixel values as tree canopy.” This command then programmatically assigns all other pixels that have similar values as a tree canopy. This process is then repeated 100 times (one for each of the 100 *Iso Cluster Unsupervised Classification* classes).

If a value is classified as *Unknown*, our analyst will then repeat the *Iso Cluster Unsupervised Classification* process again only on the *Unknown* values and the process is repeated until there are no more *Unknowns*.

This study focuses on high canopy only, as shown in the graphic below. Small shrubs and low lying vegetation were not considered as part of the tree canopy. In some cases, very thick low lying vegetation (as in abandoned empty lots) will show up as tree canopy. Our study attempts, through our Quality Control (QC) process (see next section) to limit this vegetation from being classified as canopy cover. For the purpose of this study we are classifying all low vegetation as *Non-Canopy*.



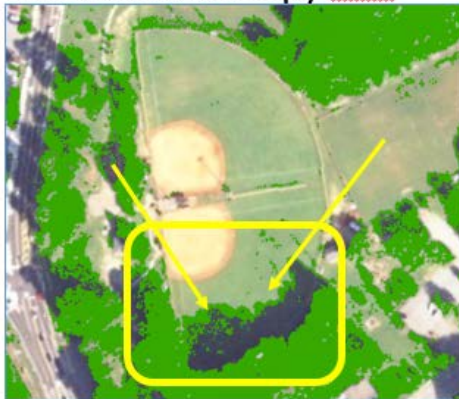
This image shows examples of vegetation that are classified as Tree Canopy. Image Source: Arbor Day Foundation

## Quality Control (QC)

Once our analysis is complete, our QC Lead visually inspected and identified major errors in the classification process. Errors are identified and corrected in the method outlined below. In this example, the baseball fields at Blackburn Park have been identified as having major errors.

1. Several thick patches of tree shadows are incorrectly classified as tree canopy on the baseball field.
2. Our analyst created a polygon-shaped baseball field over the area that needs to be corrected
3. Pixels are reclassified within the baseball field layer to *Non-Canopy*
4. All pixels on the baseball field are classified correctly

1 Incorrect canopy ID'd



2 Manual reclassify area



3 Reclass shadow

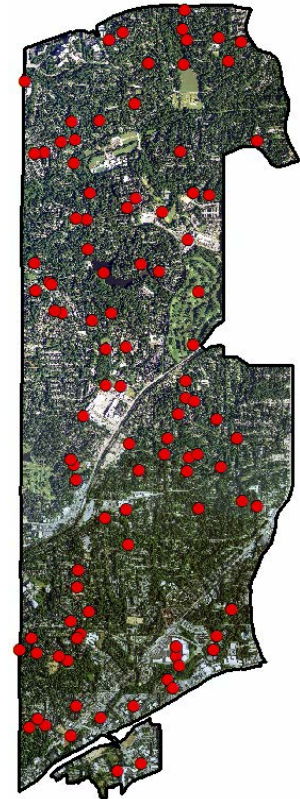


4 Completed process

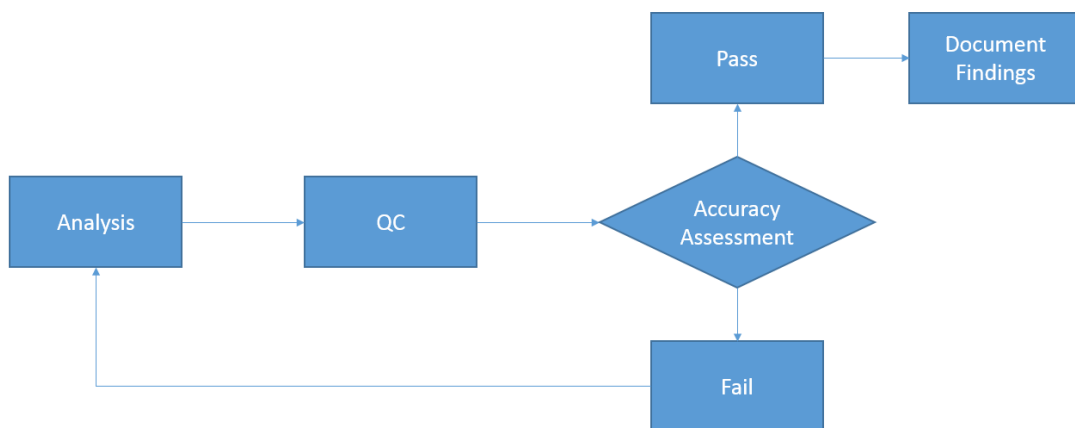


## Determining Accuracy Threshold

Using a random point generator tool, we generated 100 points within the City limits. Each one of those points were manually classified by our analyst as *Canopy* or *Non-canopy*. We compared those classifications with the classifications determined in the automated classification process described above. To pass our accuracy threshold we required a score of 90% or higher. A review of several other tree canopy studies indicated that an accuracy assessment greater than 90% is well above the industry standard for this type of study. If less than 90 points matched, then our team would go back and fix the errors until we received a higher than 90% accuracy threshold. The graphic below shows this process:



*Red dots indicate the location of random samples used to determine accuracy*



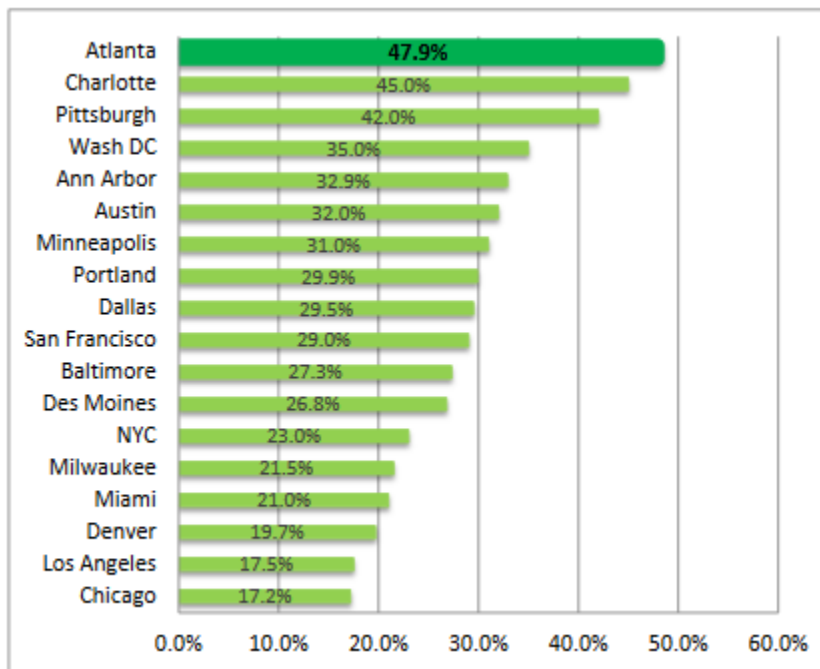
*Flowchart describing the overview of the analysis, QC, and accuracy assessment*

## Comparison Cities

A quick comparison of tree canopy coverage for other cities in the Atlanta area are shown below.

Atlanta Region Comparison Cities	Year	Percent Tree Coverage
City of Decatur	2010	45.1%
City of Atlanta	2014	47.9%
City of Avondale Estates	2015	54.0%
City of Sandy Springs	2015	62.0%
City of Brookhaven	2015	53.6%

This table was developed and published in the 2014 City of Atlanta Urban Tree Canopy Study by the Georgia Tech Center for Geographic Information Systems. This table compares urban tree canopy percentages (UTC %) with other major metropolitan areas in the United States.



Percent Tree Canopy Estimates. Source: Atlanta Urban Tree Canopy

### Note

- Due to a large annexation that occurred on the south end of the city in January of 2015, some discrepancies may be embedded in the results. When this occurs, this study does its best to either note the discrepancies or standardize the results to best explain the change in canopy.
- This study does not include the recent Woodcliff Drive annexation.

## References and Data Sources

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