TREE CANOPY COVER

ASSESSMENT

OAK ISLAND,

NORTH CAROLINA

SEPTEMBER | 2023

PlanIT Geo™
developers of TreePlotter

earthdefine

Town of Oak Island
"A Place to Coast"
North Carolina

NORTH CAROLINA FOREST SERVICE NC

north carolina urban forest council

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7,093
ACRES OF CANOPY

59%
OF OAK ISLAND'S LAND AREA WAS COVERED WITH CANOPY IN 2022

EXECUTIVE SUMMARY

BACKGROUND OF THIS ANALYSIS

Oak Island distinguishes as one of North Carolina's premier beach locations, situated along the Southeastern Coast of the state. This barrier island is celebrated for its networks of bicycle and pedestrian pathways, historical lighthouse, and the nesting and hatchings of loggerhead sea turtles. Oak Island encompasses approximately 19.8 square miles, or 12,718 acres, within the jurisdiction of Brunswick County. It's urban forest serves as an invaluable addition to the rich natural environment, providing residents, businesses, and visitors with many environmental, social, and economic benefits. This assessment mapped tree canopy (TC), possible planting area (PPA), and analyzed how they are distributed throughout Oak Island's town boundary, zoning, right-of-way (ROW), and census block groups. Oak Island's urban forest is a valuable asset. **For the purpose of this report, total tree canopy refers to percentage of tree canopy coverage for the town's total land excluding water bodies.**

PROJECT METHODOLOGY

The results, based on 2022 imagery from the USDA's National Agriculture Imagery Program (NAIP), provide a near-current look at land cover in Oak Island and will allow the Town to revise existing and develop new strategies to protect and expand the urban forest throughout both public and private lands. This study utilized modern machine learning techniques to create land cover data that are more reproducible and will allow for a more uniform comparison in future tree canopy and land cover assessments.

OAK ISLAND'S FORESTS

In 2022, Oak Island had 59% tree canopy cover and 23% possible planting area, and the other 18% of the town was classified as unsuitable for planting without significant land modification. The Town's total area, **including water bodies,** was categorized by 56% tree canopy, 2% shrubs, 21% non-canopy vegetation; 4% soil/dry vegetation; 12% impervious surfaces, and 6% water. The 7,093 acres of tree canopy in Oak Island provide ecosystem benefits valued at over $2.6 million per year through air quality improvements, stormwater runoff prevention, and carbon sequestration.

Results from this assessment found that canopy cover changed from 50% to 59% from 2014 to 2022 (+9% or 1,113 acres) using the current town boundary. Regenerative growth of preexisting forest patches contributed the most to the town's canopy gain. The town's mainland extension is predominately forested, categorized by expansive, uninhabited woodlands. These sizable tracts are likely candidates for prospective developmental properties as the town undergoes inland expansion. Given these considerations, it becomes crucial to prioritize residential zones for canopy preservation in tandem with the Town's expansion.

EXECUTIVE SUMMARY

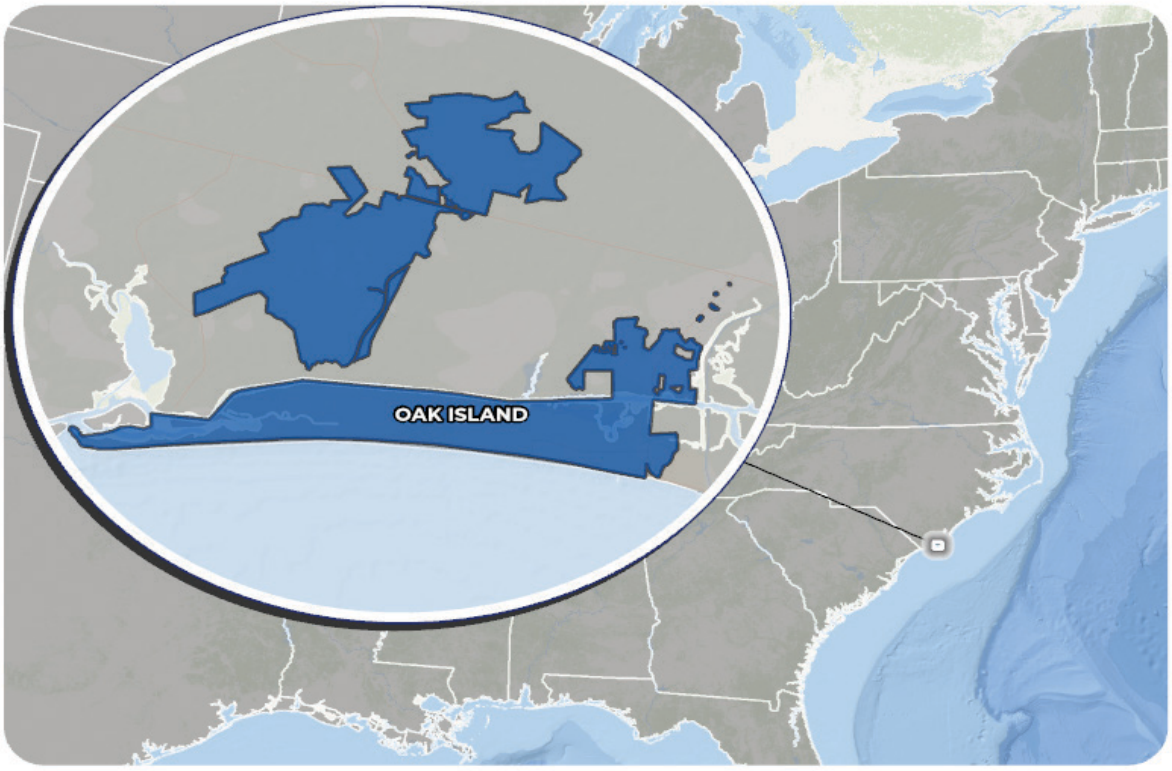


Figure 1. The Town of Oak Island occupies approximately 19 square miles along the southeastern coast of North Carolina.

RECOMMENDATIONS

The findings from this analysis can serve as a foundation for crafting an ongoing plan to safeguard and enhance Oak Island's urban forest. This study revealed that the Town of Oak Island contains 7,093 acres of tree canopy. With 2,736 acres of possible planting area, Oak Island has the opportunity to continue to increase tree canopy coverage on both public and private property.

It is important for the Town to use this assessment to inform future investments in the urban forest so that all those who live, work, and play in Oak Island can benefit from the urban forest. The Town should proactively work to protect the existing urban forest and replenish the canopy with additional trees in new developments. Through management actions, strategic plantings, and protections for existing canopy informed by the TC and PPA metrics included in this report, the Town of Oak Island has an exciting opportunity to expand the quality and quantity of its current tree canopy for the benefit of future generations.

59%
TREE CANOPY COVER

23%
POSSIBLE PLANTING AREA

12%
IMPERVIOUS SURFACE

Figure 2. Based on an analysis of 2022 high-resolution imagery, Oak Island contains 59% tree canopy, 23% areas that could support canopy in the future, and 12% impervious surface areas. Percentages based on land acres.

PROJECT

METHODOLOGY

Land cover, tree canopy, and possible planting areas were mapped using the sources and methods described below. These data sets provide the foundation for the metrics reported at the selected geographic assessment scales.

DATA SOURCES

This assessment utilized high-resolution (60-centimeter) multispectral imagery from the U.S. Department of Agriculture's National Agriculture Imagery Program (NAIP) collected in 2022 to derive the land cover data set. The NAIP imagery was used to classify all types of land cover.

MAPPING LAND COVER

The land cover data set is the most fundamental component of an tree canopy assessment. Tree canopy and land cover data from the EarthDefine US Tree Map (https://www.earthdefine.com/treemap/) provided a six class land cover data set. The US Tree Map is produced using a modern machine learning technique to extract tree canopy cover and other land cover types from the latest available 2022 and 2014 NAIP imagery. These six classes are shown in Figure 3 and described in the Glossary found in the Appendix.

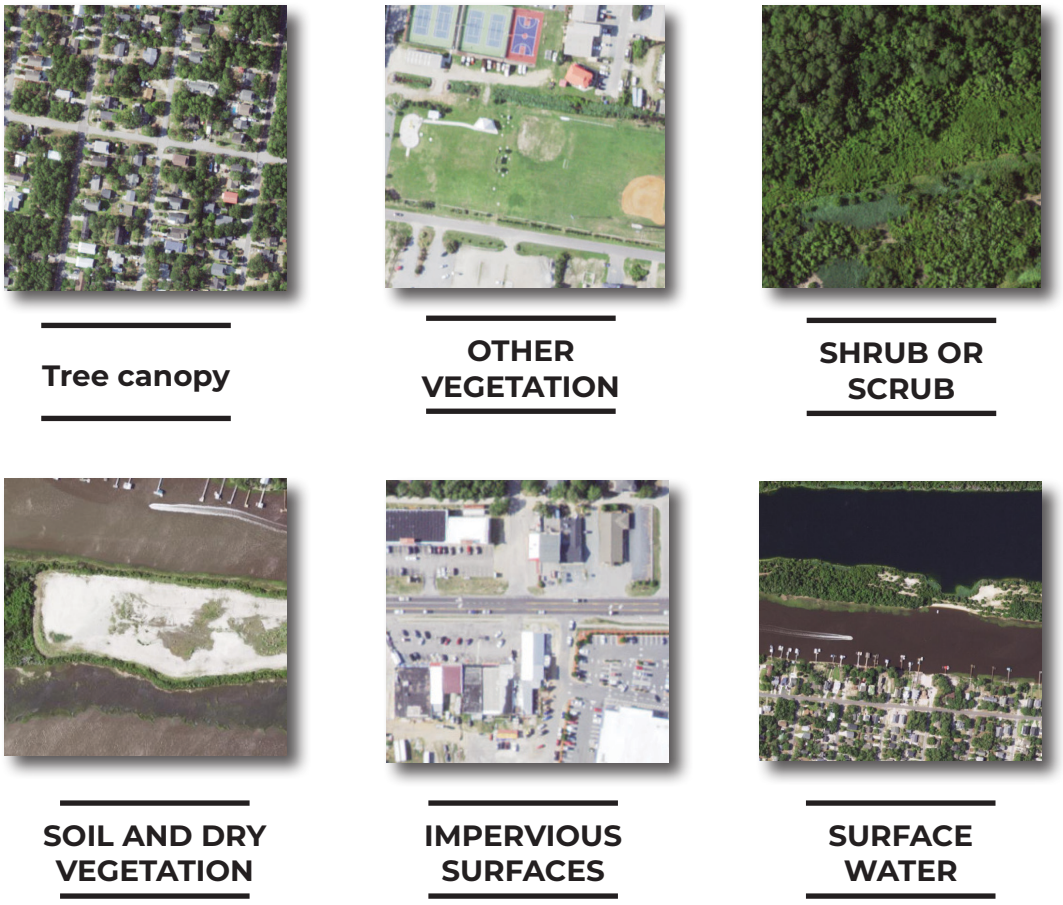


Figure 3. Six (6) distinct land cover classes were identified in the 2022 tree canopy assessment: tree canopy, shrubs, other vegetation, bare soil and dry vegetation, impervious surfaces, and water.

IDENTIFYING POSSIBLE PLANTING AREAS AND UNSUITABLE AREAS FOR PLANTING

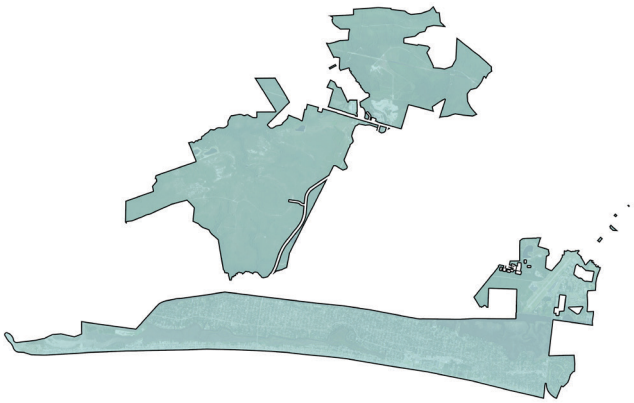
In addition to quantifying the Town of Oak Island's existing tree canopy cover, another metric of interest in this assessment was the area where tree canopy could be expanded. To assess this, all land area in the Town of Oak Island that was not existing tree canopy coverage was classified as either possible planting area (PPA) or unsuitable for planting.

Possible planting areas were derived from the vegetation and shrubs layer. Unsuitable areas, or areas where it was not feasible to plant trees due to biophysical or land use restraints (e.g. golf course playing areas, recreation fields, utility corridors, airports, etc.) were manually delineated and overlaid with the existing land cover data set (Figure 4). The final results were reported as PPA Vegetation, Unsuitable Impervious, Unsuitable Vegetation, Unsuitable Soil, and Water.

Figure 4.
Vegetated areas where it would be biophysically feasible for tree plantings but undesirable based on their current usage (left) were delineated in the data as "Unsuitable" (right). These areas included recreational sports fields, golf courses, and other open space.

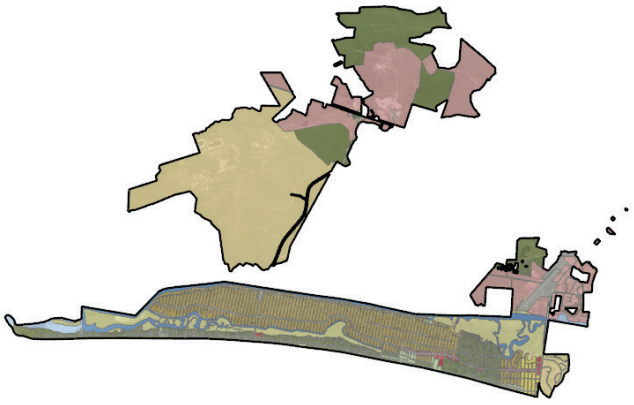
DEFINING ASSESSMENT LEVELS

In order to best inform Oak Island's various stakeholders, tree canopy and other associated metrics were tabulated across a variety of geographic boundaries. These boundaries include the town boundary, zoning, census block groups, public property, and parcels.



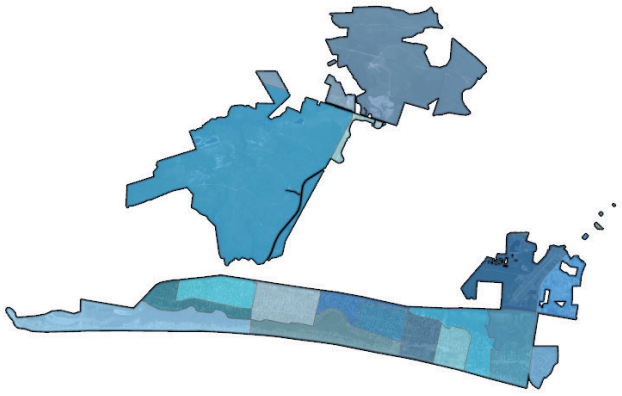
Town Boundary

Oak Island's **town boundary** is the one (1) main area of interest over which all metrics are summarized.



Zoning

Thirteen (13) **zoning** types were analyzed to assess the impact of zoning ordinances and policy on a smaller scale.

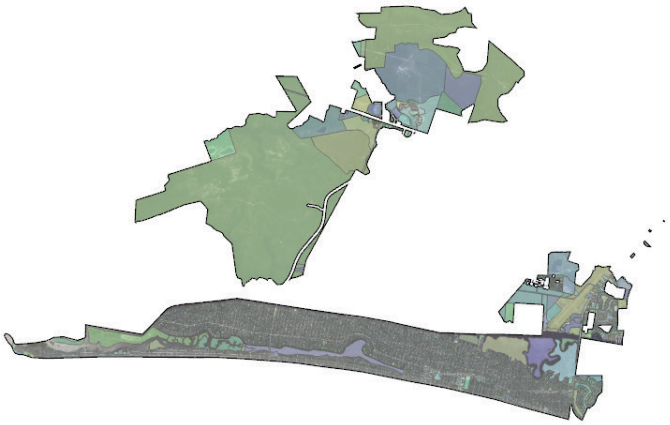


Census Block Groups

Twenty (20) **census blocks groups** were assessed to show relationships between canopy and sociodemographic factors, and highlight potential environmental justice issues.

Public Property

One hundred and forty (140) **public property** parcels were analyzed to determine how tree canopy differs on land owned by different public entities.



Parcels

The smallest unit of analysis was **parcels,** of which there were over twelve thousand (12,607) total. This granular assessment level reveals hidden information that larger scales may show.

Figure 5. Five (5) distinct geographic boundaries were explored in this analysis: the Town boundary, zoning, census block groups, public property, and parcels.

STATE OF THE CANOPY AND

KEY FINDINGS

OK-R-6 (RESIDENTIAL) AREAS LOST 176 ACRES OF CANOPY IN EIGHT YEARS.

OK-CLD (COMMERIAL LOW DENSITY DISTRICT) ZONED AREAS HAVE 530 ACRES OF POSSIBLE PLANTABLE SPACE.

OAK ISLAND GAINED 1,113 ACRES OF CANOPY FROM 2018 TO 2022.

OAK ISLAND'S TREES PROVIDE OVER $2.5 MILLION IN ANNUAL ECOSYSTEM BENEFITS.

+9% CANOPY CHANGE

23% PLANTABLE SPACE

59% TREE CANOPY

12% IMPERVIOUS

1% OF TREE CANOPY SHADES IMPERVIOUS

This study mapped and quantified tree canopy, plantable space, and canopy change throughout the Town of Oak Island. These metrics help inform a strategic approach for identifying existing canopy to preserve as well as areas suitable to plant trees in the future. Tree canopy cover, possible planting area, and areas unsuitable for planting are represented as percentages of the Town's land area with bodies of water excluded.

TOWN-WIDE TREE CANOPY COVER

This tree canopy assessment utilized the land cover data as a foundation to determine tree canopy cover and possible planting areas (PPA) throughout the Oak Island. After assessing the Town's 12,001 land acres, 59% was found to be covered with canopy. Even though Oak Island's canopy covers over half the town, there is still space to plant more trees. There are still 2,736 acres available for tree planting opportunities. If the Town utilized 100% of its plantable space, it would theoretically have the potential to reach 82% tree canopy cover.

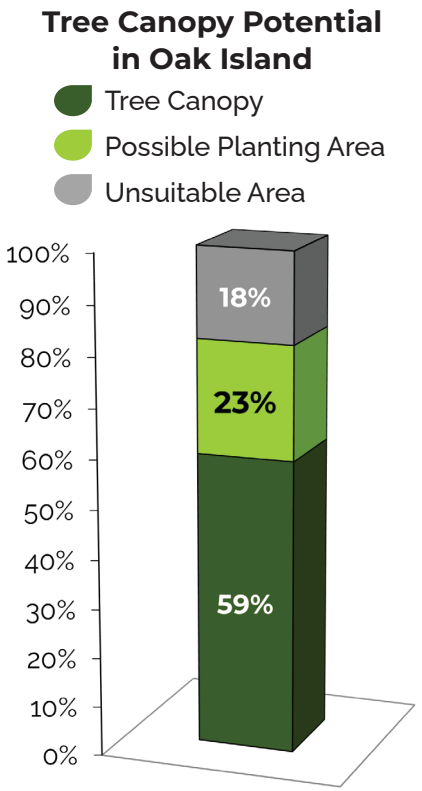


Figure 6. Tree canopy, possible planting area, and area unsuitable for tree canopy in Oak Island.

However, not all of the land area in town is feasible for trees. About 12% of the town is covered with impervious surfaces such as roads and parking lots. There is also another other 6% composed of recreational sports fields, areas of bare sand and dry vegetation. Altogether, 18% of the town is not a good fit for trees.

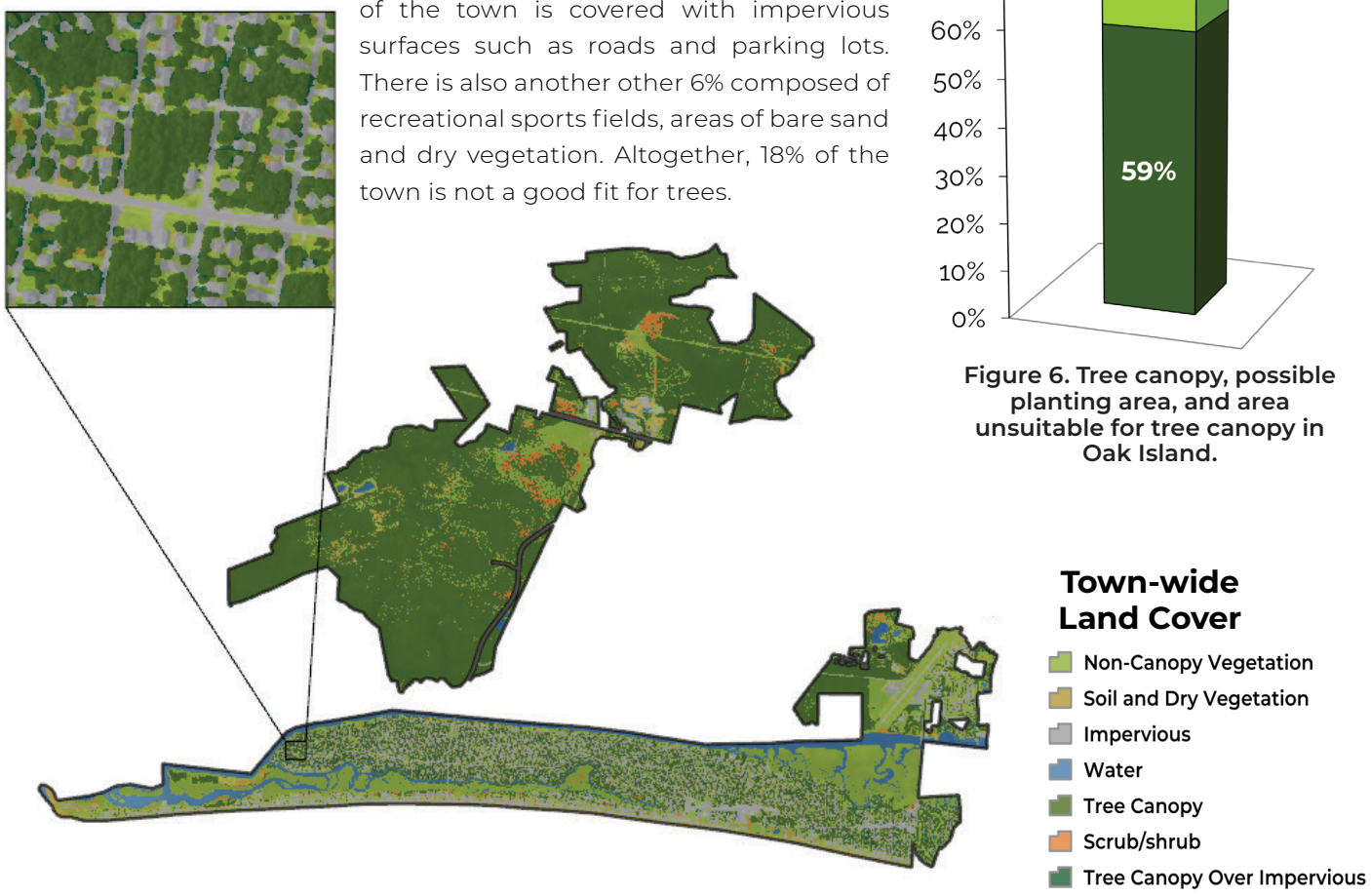


Figure 7. Distribution of land cover throughout the town boundary.

TOWN-WIDE TREE CANOPY CHANGE

Over the 8-year study period, there was an overall increase in Oak Island's tree canopy. Tree canopy increased by 1,113 acres, a 9% raw increase from 2014 to 2022. However, it can be assumed that the tee canopy fluctuated throughout the eight-year study period. This assessment serves as a snapshot of the canopy at the time of imagery collection. Generally, most large losses of canopy can be traced back to development along Oak Island Drive. Canopy growth can be attributed to the growth of existing trees and natural regeneration. Current levels of tree canopy in Oak Island can continue to be improved with careful planning and planting efforts of native species.

Table 1. Tree canopy cover assessment results by acres and percent. (Percentages based on land acres.)

Study Area	Total Area	Land Area	2014 Tree Canopy		2022 Tree Canopy		Canopy Change	
	Acres	Acres	Acres	%	Acres	%	Acres	%
Oak Island	12,718	12,001	5,980	50%	7,093	59%	1,113	9%

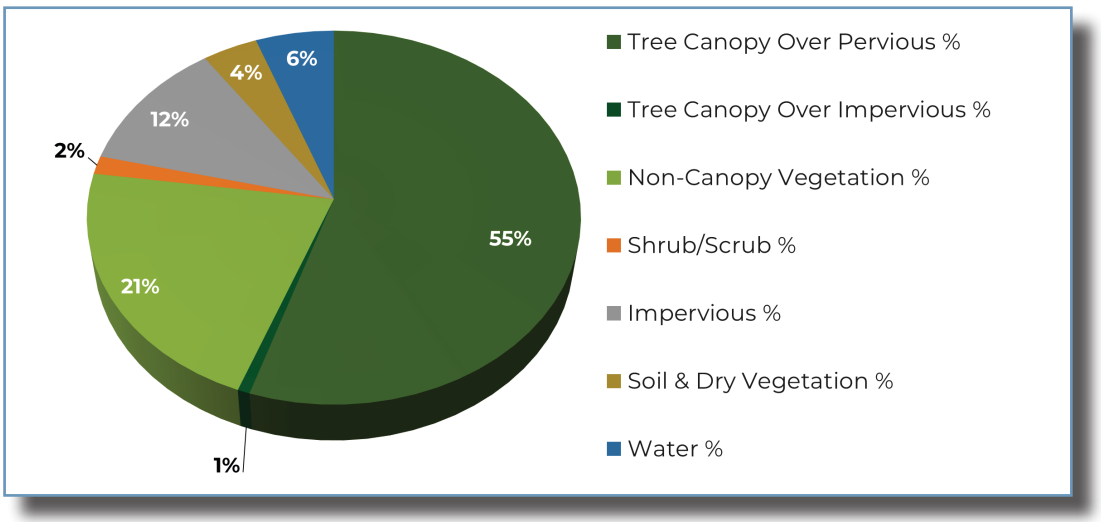


Figure 8. *Distribution of land cover (percentages based on total acres including water bodies).*

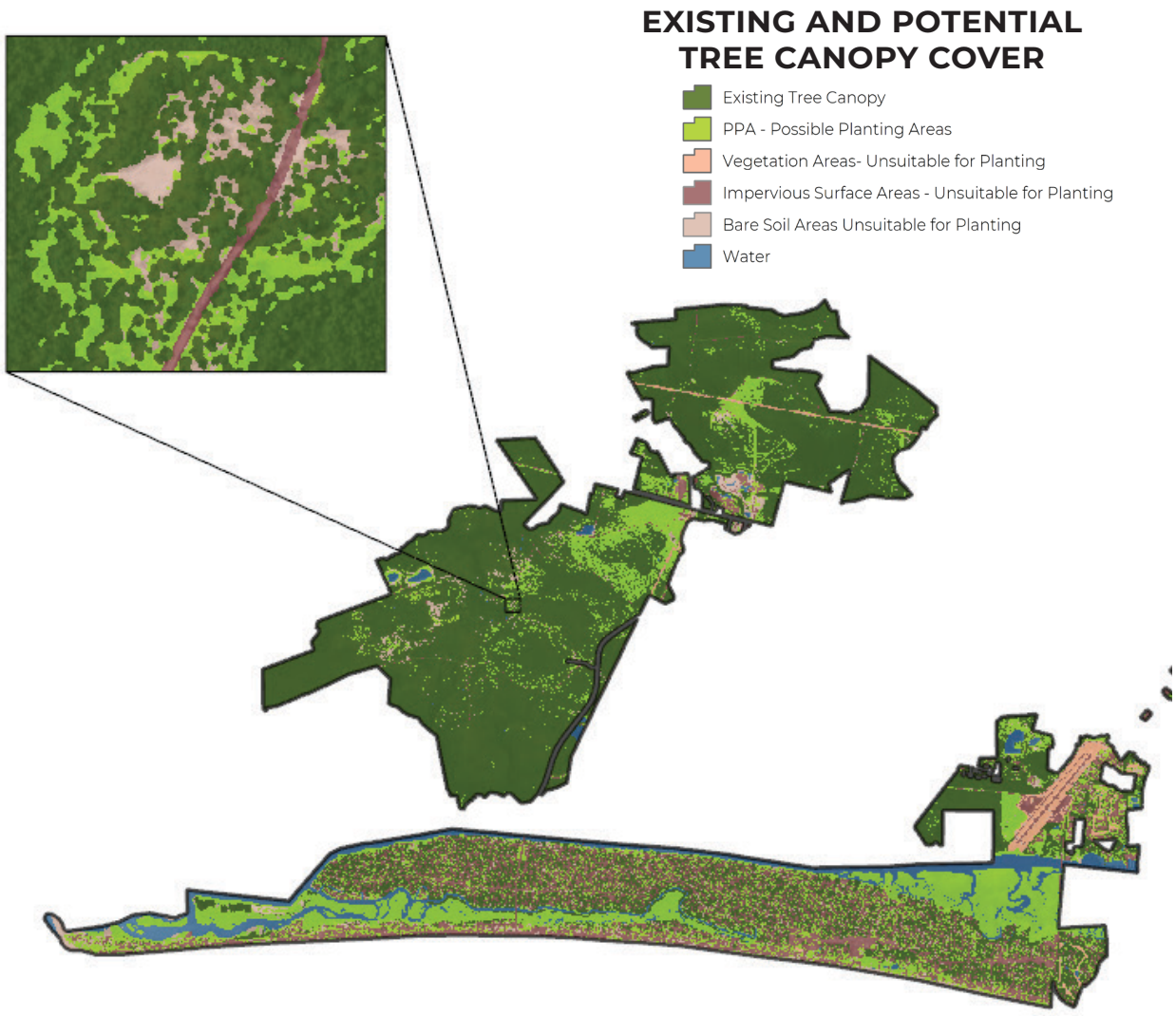


Figure 9. Distribution of existing and potential tree canopy cover throughout the Town.

TREE CANOPY COVER BY ZONING

Tree canopy and PPA were assessed for Oak Island's 14 zoning types. A majority of the town area falls under two categories: OK-R-20 (Low Density Residential District) and OK-CLD (Commercial Low Density District) with 21% and 32% of land area respectively. Remarkably, Low Density Residential District contained almost half (46%) of all the tree cover on Oak Island, featuring an impressive 90% canopy cover within its own boundaries. However, this extensive canopy is largely attributed to the expansive undeveloped forested areas situated on the mainland. Given these circumstances, protective ordinances and strategic collaborations with property developers should be prioritized to safeguard these forested areas.

The areas zoned for OK-R-7 (Medium Residential District) and OK-R-20 (Low Density Residential District) saw about a 20% increase in tree canopy cover (19% and 18% respectively). OK-CLD (Commercial Low Density District) areas added a significant 271 acres.

Only two zoning types exhibited significant losses in canopy. OK-R-6 (Residential District) areas lost 176 acres, or 11% of its tree canopy cover in 8 years These losses occurred in developments along East Oak Island Drive. OK-R-6MH (Higher Density Residential District) also lost 11% of it's trees, dropping its canopy cover from 60% to 49% during the study period. All other zoning types had small changes, gaining or losing less than 10 acres of trees.

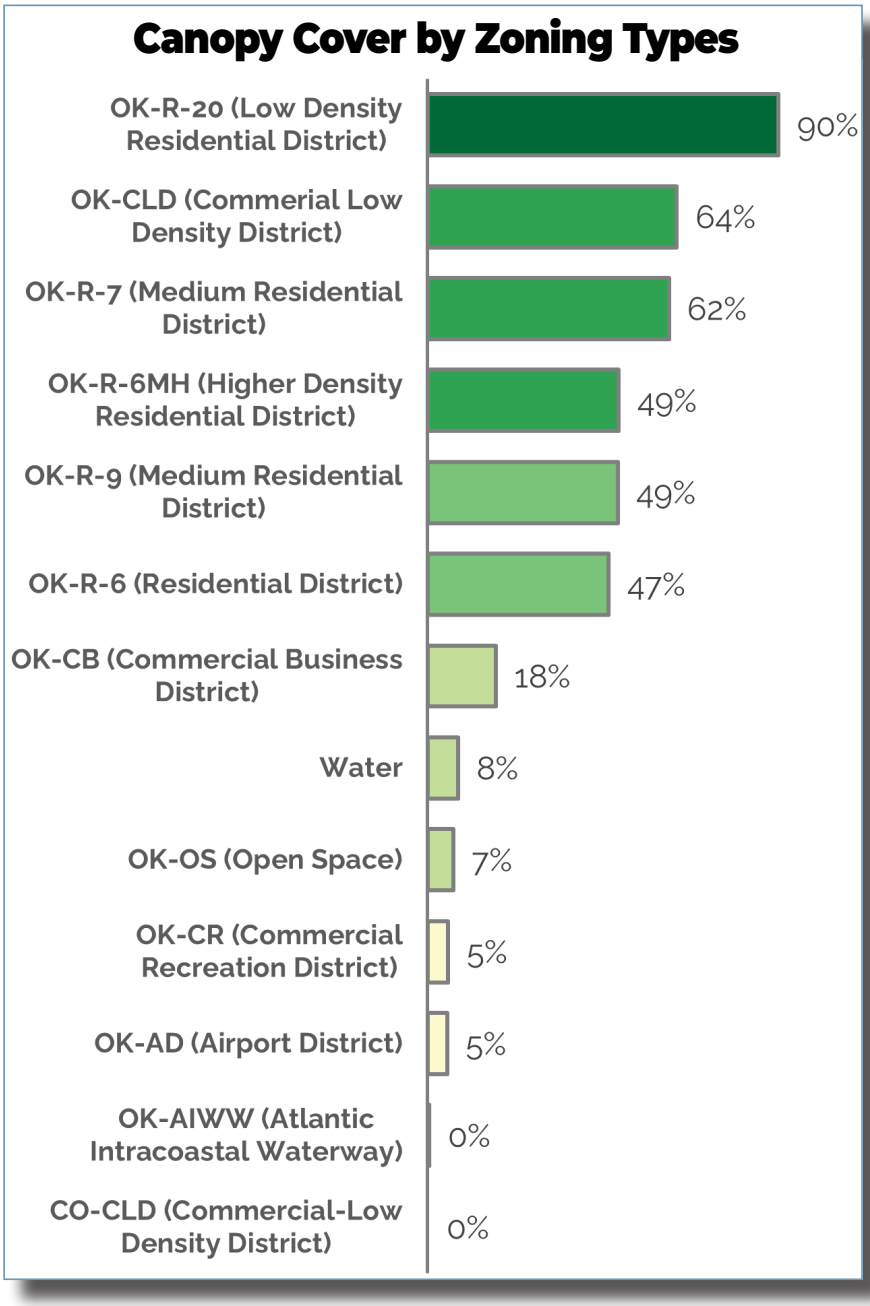
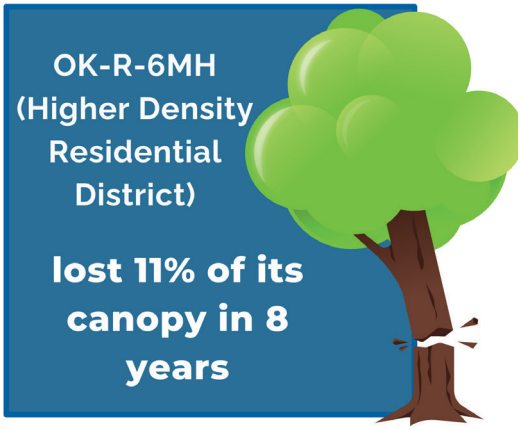
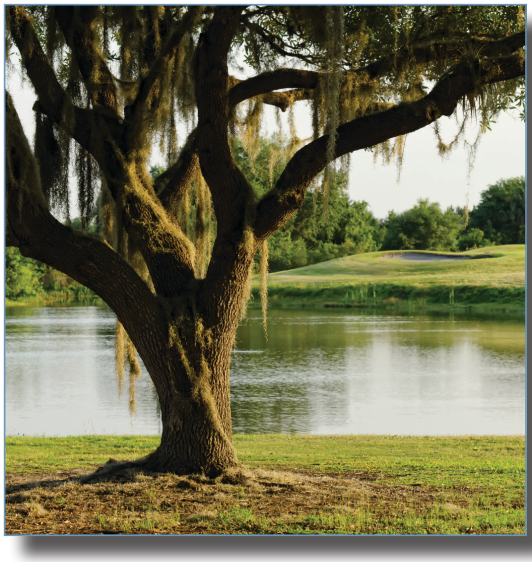


Figure 10. Tree canopy percent by zoning.





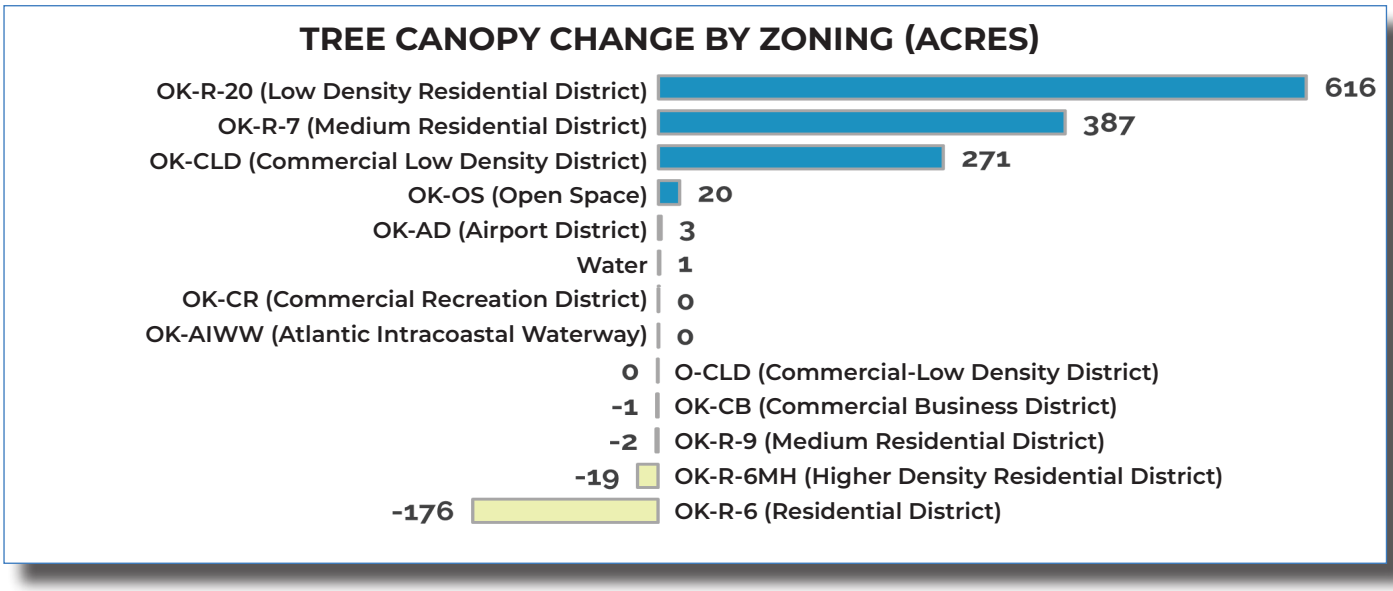


Figure 11. Tree canopy change percent by zoning in Oak Island from 2014-2022.

Table 2. Tree canopy coverage, potential planting area, and tree canopy change by zoning districts.

Zoning Districts	*Total Area*	*Land Area*	*2022 Tree Canopy*		*2022 PPA*		*Canopy Change*	
	Acres	*Acres*	Acres	%	Acres	%	Acres	%
OK-R-20 (Low Density Residential District)	3,514	3,489	3,153	90%	212	6%	616	18%
OK-CLD (Commercial Low Density District)	2,342	2,307	1,481	64%	530	23%	271	12%
OK-R-7 (Medium Residential District)	2,098	2,071	1,288	62%	459	22%	387	19%
OK-R-6MH (Higher Density Residential District)	175	175	86	49%	42	24%	-19	-11%
OK-R-9 (Medium Residential District)	85	85	42	49%	19	22%	-2	-2%
OK-R-6 (Residential District)	1,551	1,543	721	47%	332	22%	-176	-11%
OK-CB (Commercial Business District)	78	78	14	18%	17	22%	-1	-1%
Water	552	96	7	8%	83	87%	1	1%
OK-OS (Open Space)	911	849	56	7%	775	91%	20	2%
OK-CR (Commercial Recreation District)	87	87	5	5%	26	30%	0	1%
OK-AD (Airport District)	150	150	8	5%	11	7%	3	2%
OK-AIWW (Atlantic Intracoastal Waterway)	135	40	0	0%	24	61%	0	0%
CO-CLD (Commercial-Low Density District)	1	1	0	0%	1	66%	0	0%

TREE CANOPY COVER BY PUBLIC PROPERTY

The assessment was also conducted within the Town's public property parcels. This metric helps quantify trees managed and maintained by the town. These 140 public property parcels, were predominately situated in proximity to the Intracoastal Waterway and its floodplain. The trees present in a riparian corridor (areas surrounding rivers and streams) provide many benefits. These benefits range from removing microscopic pollutants, intercepting and absorbing stormwater, and providing shade to regulate aquatic temperatures to name a few.

Tree canopy across these public tracts constituted a mere 12%- considerably less than the town-wide average of 59%. Although, 80% of this layer was deemed suitable for future tree plantings, planting trees or other vegetation near the Atlantic Intracoastal Waterway comes with many challenges. These areas may not be viable planting sites because the lands are controlled by the federal or state government, or because they are often inundated by tides. It is important to ground truth these areas before planning planting events.

OAK ISLAND'S PUBLIC PROPERTY
contains 775 acres of possible plantable area

Coastal areas present unique challenges for vegetation due to salt spray, sandy soils, inundation from tides, and frequent storms. However, certain tree species are well-adapted to thrive in these conditions along the coast of North Carolina.

Most instances of canopy loss occurred in parcels along SE 48th Street and developments surrounding the Oak Island Par 3 Golf Course on the eastern side of town. However, these changes were minor, the largest loss of canopy in a single area did not exceed 1.5 acres. Conversely, the most significant canopy increase (14 acres) was observed on the land mass between the Intracoastal Waterway and the Montgomery Slough (Figure 12). Significant canopy gains also occurred behind the water tower near Davis Creek Kayak Dock. These areas of growth can be attributed to natural regeneration and flourishing existing canopy.

Figure 12. Tree canopy cover in Oak Island's Intracoastal Waterway.

TREE CANOPY BY CENSUS BLOCK GROUPS

TC and PPA were also assessed at the census block group level. Census block groups contain clusters of census block boundaries. This is the second smallest geographic unit of measure at which the U.S. Census publishes statistical data within a state and represents between 600 and 3,000 people. Census block groups are particularly valuable for assessing the equitable distribution of tree canopy throughout the town, as the block groups are linked to readily available demographic and socio-economic data. Results indicated that canopy cover varied substantially throughout Oak Island's 20 census block groups, as seen in Figure 13.

The census block group in the northern part of the town has the largest canopy cover, at 84%. However, most areas (7 out of 20) have between 40-50% canopy cover. The block groups with the least amount of tree cover can be found along the coast.

Over the last eight years, 13 out of 20 census block groups lost some of their tree cover. The area that lost the most canopy acres can be found between N Middleton Ave and Highway 133 along E Oak Island Dr. This block group lost 38 acres or 8% of its canopy. On the other hand, the northern portion of the town saw a large increase in tree cover - up to 21% in one block group. This area gained 814 acres of canopy in just 8 years.

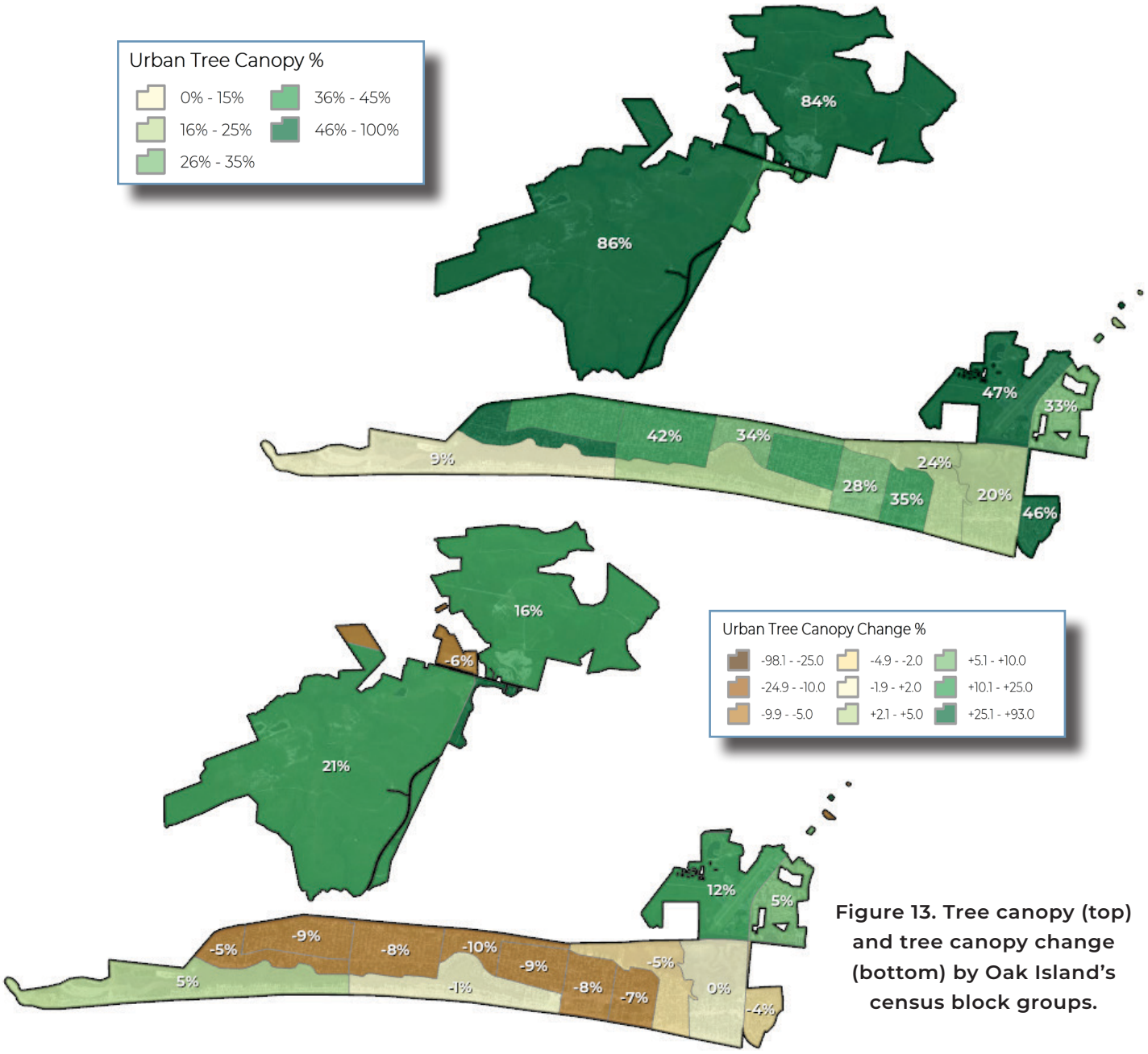


Figure 13. Tree canopy (top) and tree canopy change (bottom) by Oak Island's census block groups.

TREE CANOPY BY PARCELS

Tree canopy cover and PPA were assessed for the town's 12,607 individual parcels. Short of quantifying every individual tree, this unit of measure provides the finest possible scale at which to interpret the results, defining TC and PPA metrics for every parcel within the town boundary. Only 11% of the Town's parcels had a tree canopy cover of 10% or lower. However, 88% of parcels met or exceeded the town-wide average of 59%. 10,971 parcels were entirely covered by canopy while 1,410 had no canopy at all. At 24%, the average canopy cover of all parcels fell short of the town-wide average of 36%. For the full tree canopy results by parcel, refer to the Parcels shapefile in a GIS software.

Figure 14. Tree canopy (top) and tree canopy change (bottom) by parcels.

ASSESSMENT OF ECOSYSTEM BENEFITS

Using the best available science from i-Tree tools, values were calculated for some of the benefits and functions provided by the tree canopy in Oak Island, North Carolina. The following values were calculated using the USDA Forest Service's i-Tree Landscape tool with Oak Island's total acres of tree canopy as the input data.

AIR QUALITY

Trees produce oxygen, indirectly reduce pollution by lowering air temperature, and improve public health by reducing air pollutants which cause death and illness. The existing tree canopy in Oak Island removes approximately 610,300 pounds of air pollution annually, valued at over $587,790.

STORMWATER AND WATER QUALITY

Trees and forests mitigate stormwater runoff which minimizes flood risk, stabilizes soil, reduces sedimentation in streams and riparian land, and absorbs pollutants, thus improving water quality and habitats. The tree canopy in Oak Island absorbs almost 47 million gallons of water per year. Extrapolated county wide, this means that Oak Island's existing canopy provides over $418,800 million annually in stormwater benefits

CARBON STORAGE AND SEQUESTRATION

Trees accumulate carbon in their biomass; with most species in a forest, the rate and amount increase with age. The trees of Oak Island store approximately 229,500 tons of carbon, valued at over $39.1 million, and each year the tree canopy absorbs and sequesters 9,072 tons of carbon dioxide, valued at over $1.5 million.

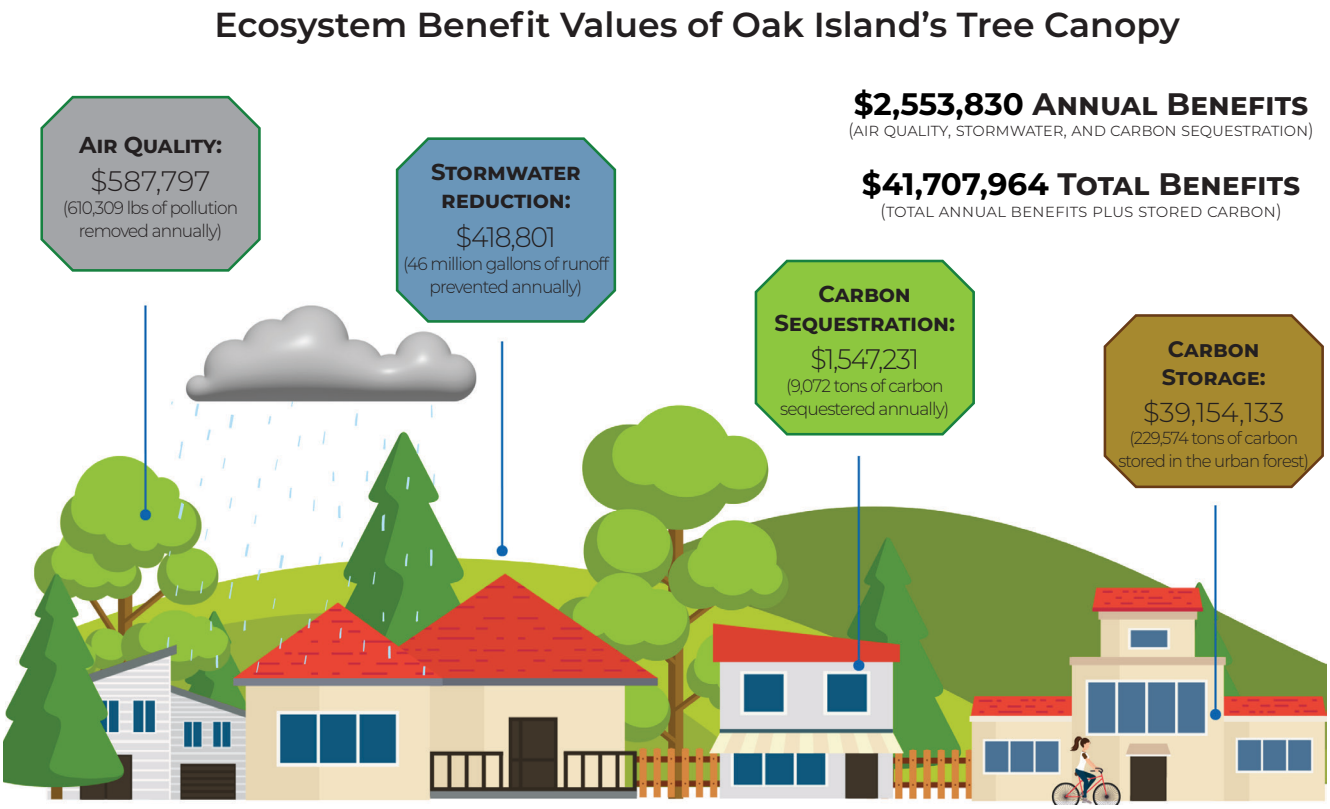


Figure 15. Ecosystem service benefits of Oak Island's canopy cover.

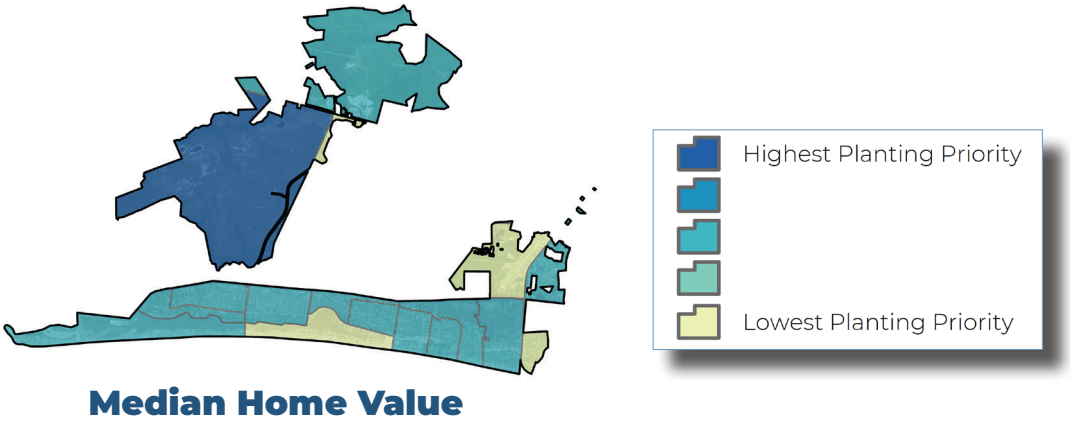
TREE PLANTING

PRIORITIZATION

Increased tree canopy cover can provide a wide array of benefits to a local community and its residents and visitors. To locate specific areas in need, socioeconomic data from the US census bureau was downloaded and analyzed at the census block group scale. Rankings are sorted from high (dark blue) to low (light yellow), so areas that contain higher home values were denoted in yellow and areas that have houses that cost relatively less were highlighted in dark blue

Median Home Value: Mature trees can increase home and property values. This criteria highlights areas with lower median home value.

NatureScore™: NatureScore, created by NatureQuant, is a measure of nature and human health created through the use of machine learning to identify correlations between environmental data sets and health conditions. Through these correlations, NatureScore determines what beneficial nature is, where it is present, and where it is lacking. This criteria highlights areas with less access to nature.



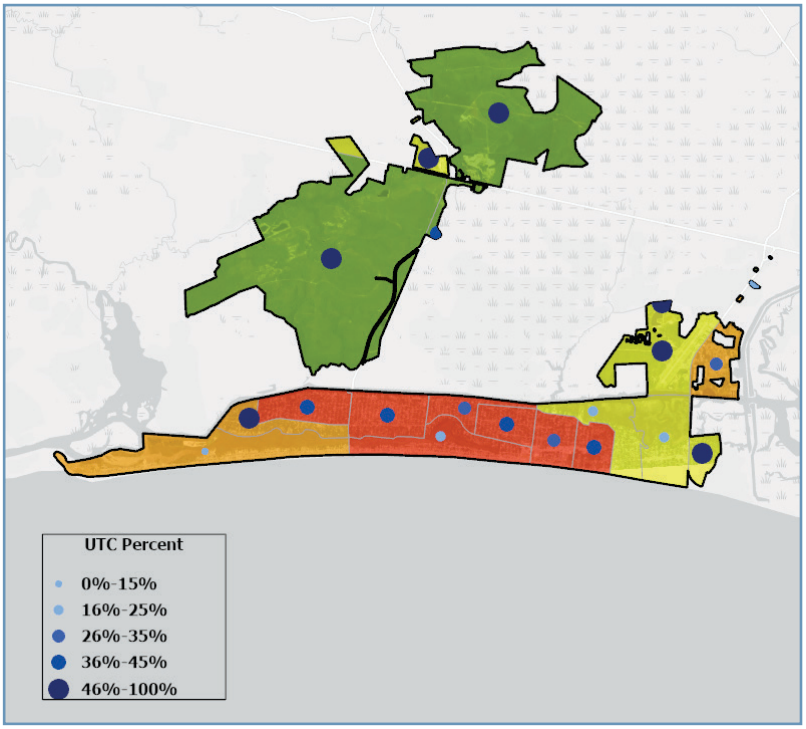


Figure 16. Census block group prioritization by median home value (top) and NatureScore™ (bottom).

Table 4. Prioritization scores by census block groups.

	People of Color Populations (%)	Median Household Income ($)	Median Home Value ($)	Poverty Rate (%)	NatureScore™
37-019-020204-2	12	32,418	211,500	46	73
37-019-020304-3	1	114,958	416,200	5	60
37-019-020304-4	6	N/A	416,200	27	50
37-019-020304-5	4	78,000	416,200	33	59
37-019-020305-2	18	44,297	221,000	31	36
37-019-020305-3	13	65,625	221,000	9	8
37-019-020308-1	6	101,042	292,200	10	35
37-019-020308-2	6	63,750	292,200	45	14
37-019-020308-3	N/A	87,857	292,200	12	23
37-019-020312-3	N/A	64,259	N/A	N/A	75
37-019-020313-1	3	88,333	233,500	20	9
37-019-020313-2	N/A	65,833	233,500	16	11
37-019-020313-3	N/A	91,477	233,500	20	11
37-019-020314-1	7	63,351	477,500	17	8
37-019-020315-1	N/A	67,101	289,800	22	7
37-019-020315-2	8	N/A	289,800	37	14
37-019-020315-3	3	69,485	289,800	14	45
37-019-020315-4	N/A	56,786	289,800	40	52
37-019-020316-1	5	125,795	416,700	10	54
37-019-020406-3	3	89,583	385,000	8	N/A
37-019-020603-1	19	56,786	216,000	40	60

CONCLUSIONS AND RECOMMENDATIONS

Oak Island has demonstrated that it values its natural resources and wants to maintain a healthy and sustainable urban environment. Recurring assessments of the Town's tree canopy represent important steps in ensuring the long-term health of its local canopy. As the Town grows, it will be able to use these data to ensure that its canopy policies and management practices prioritize its maintenance, health, and growth. An even greater percent of canopy cover can be achieved with proper planning, investment, and care of existing trees. The Town should continue to monitor the health of the local forest and implement the following recommendations to ensure the canopy is considered during future town planning and development to sustain and enhance the benefits that trees provide to the community.

LEVERAGE THE RESULTS OF THIS ASSESSMENT TO PROMOTE TREE CANOPY

Encourage investment in urban forest monitoring, maintenance, and management; prepare supportive information for local budget requests/grant applications; help establish new canopy cover goals; engage the community and develop an urban and community forest plan to guide the management, conservation, and renewal of the Town's trees; repeat assessment at least every five years to track progress towards goals.

IDENTIFY AREAS TO PRIORITIZE CANOPY EXPANSION

Plantable space in the right-of-way is often found close to high concentrations of impervious surfaces. The Town of Oak Island can develop a proactive street tree maintenance program to take on the responsibility of planting and managing street trees, ensuring healthy trees are distributed equitably across the town. Planting near the coast can mitigate noise and light pollution that can disturb the nesting practices of loggerheads and other native turtles species.

DEVELOP OUTREACH PROGRAMS TOWARDS PRIVATE LANDOWNERS

Community outreach and education programs can better inform citizens and private landholders of the environmental, health, social, and financial benefits that trees provide. Tree canopy in Oak Island provides over $2.5 million in annual ecosystem service benefits. Tree giveaways, tree planting programs, and tree maintenance events can help to promote new tree plantings.

FOCUS NEW PLANTINGS IN HIGH PRIORITY AREAS

This report and the State's TreePlotter CANOPY application can be used to locate priority areas based on tree canopy cover, available planting space, socio-demographic factors, and nature accessibility. Efforts should focus on outreach to the residents of these neighborhoods, as well as local business and land owners, in order to promote new tree plantings and continued maintenance of existing trees.

SEPTEMBER | 2023

TREE CANOPY COVER

ASSESSMENT

OAK ISLAND, NORTH CAROLINA

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