Cambridge Urban Forest Master Plan

Task Force Meeting #5

September 27, 2018

CAMBRIDGE DEPARTMENT OF PUBLIC THE WORKS

KLEINFELDER Bright People. Right Solutions.

clf conservation law foundation

BARTLETT TREE EXPERTS SCIENTIFIC TREE CARE SINCE 1907

APPLIED ECOLOGICAL SERVICES

REED HILDERBRAND

F² VJ ASSOCIATES

OBSERVATIONS & DISCUSSION

- CANOPY COVER
- SPECIES DIVERSITY
- CANOPY EQUITY
- HUMAN EXPERIENCE

PUBLIC COMMENT

PARKING DAY


PRECIPITATION
CARBON SEQUESTRATION
A 25" diameter Red Oak sequesters 295 kilograms of carbon per year.
ENERGY USE
FOREST MASTER PLA

OBSERVATIONS & DISCUSSION

– CANOPY COVER
– SPECIES DIVERSITY
– CANOPY EQUITY
– HUMAN EXPERIENCE

PUBLIC COMMENT

Today, Cambridge has **25.3%** of its land area covered by canopy.

Cambridge has had an average net loss of **31 acres** of canopy cover every year.

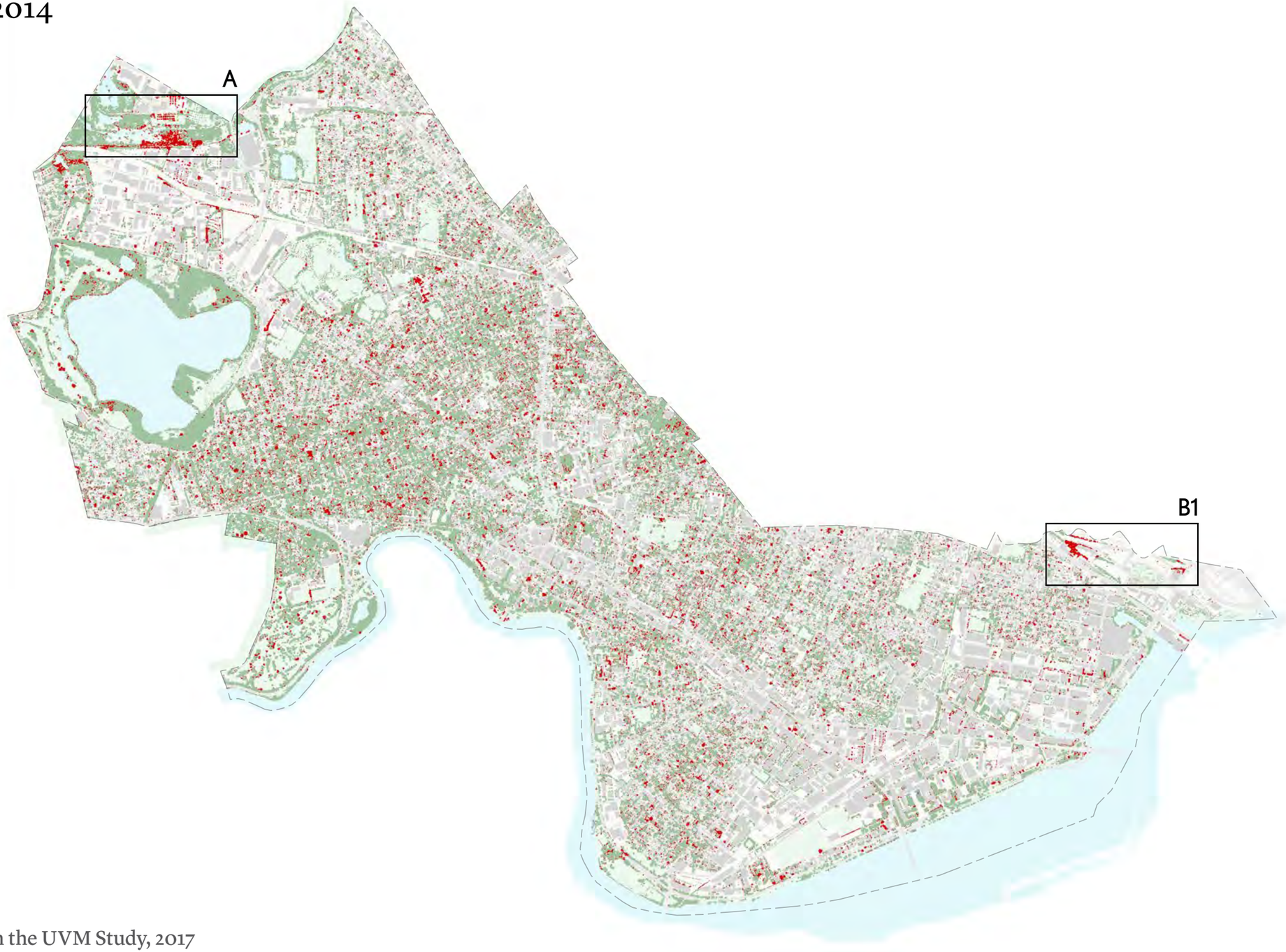
At this rate, canopy cover will be **16.2% in 2030**.

Change Between 2009-2014

2009 30.8% COVER
2014 28.3% COVER

GAIN 2.5% (101 ACRES)
LOSS 4.9% (200 ACRES)
NET – 99 ACRES

0.48% AVERAGE LOSS
OF PERCENT CANOPY COVER
PER YEAR



DRAFT

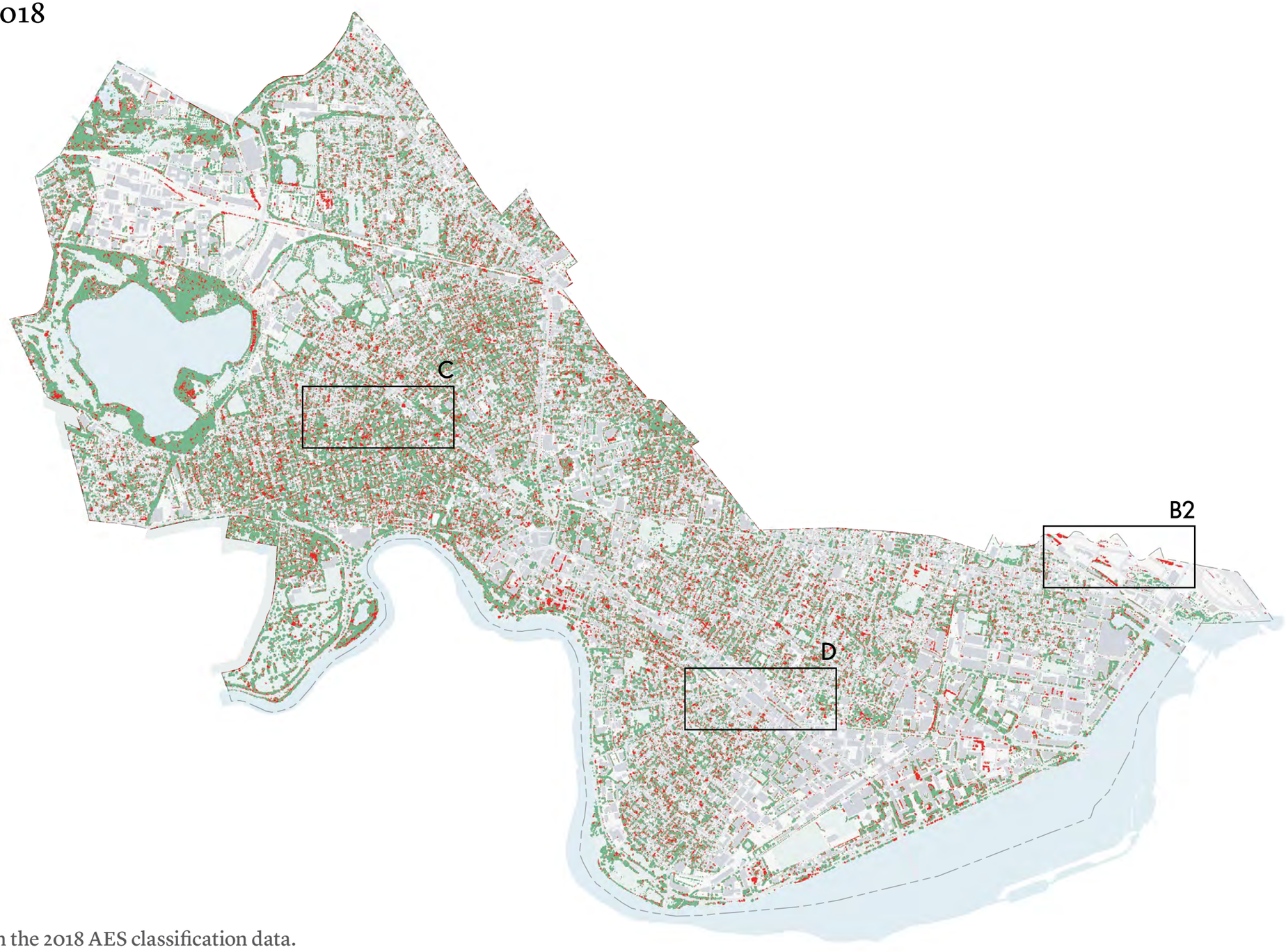
- Area of Canopy Loss
- 2014 Canopy Cover
- Open Areas

Source: Prepared by RH Team from the UVM Study, 2017

Change Between 2014-2018

2014	28.3% COVER
2018	25.3% COVER (1,027 ACRES)
GAIN	5% (206 ACRES)
LOSS	8.1% (330 ACRES)
NET	– 124 ACRES

0.76% AVERAGE LOSS OF PERCENT CANOPY COVER PER YEAR



DRAFT

- Area of Canopy Loss
- 2018 Canopy Cover
- Open Areas

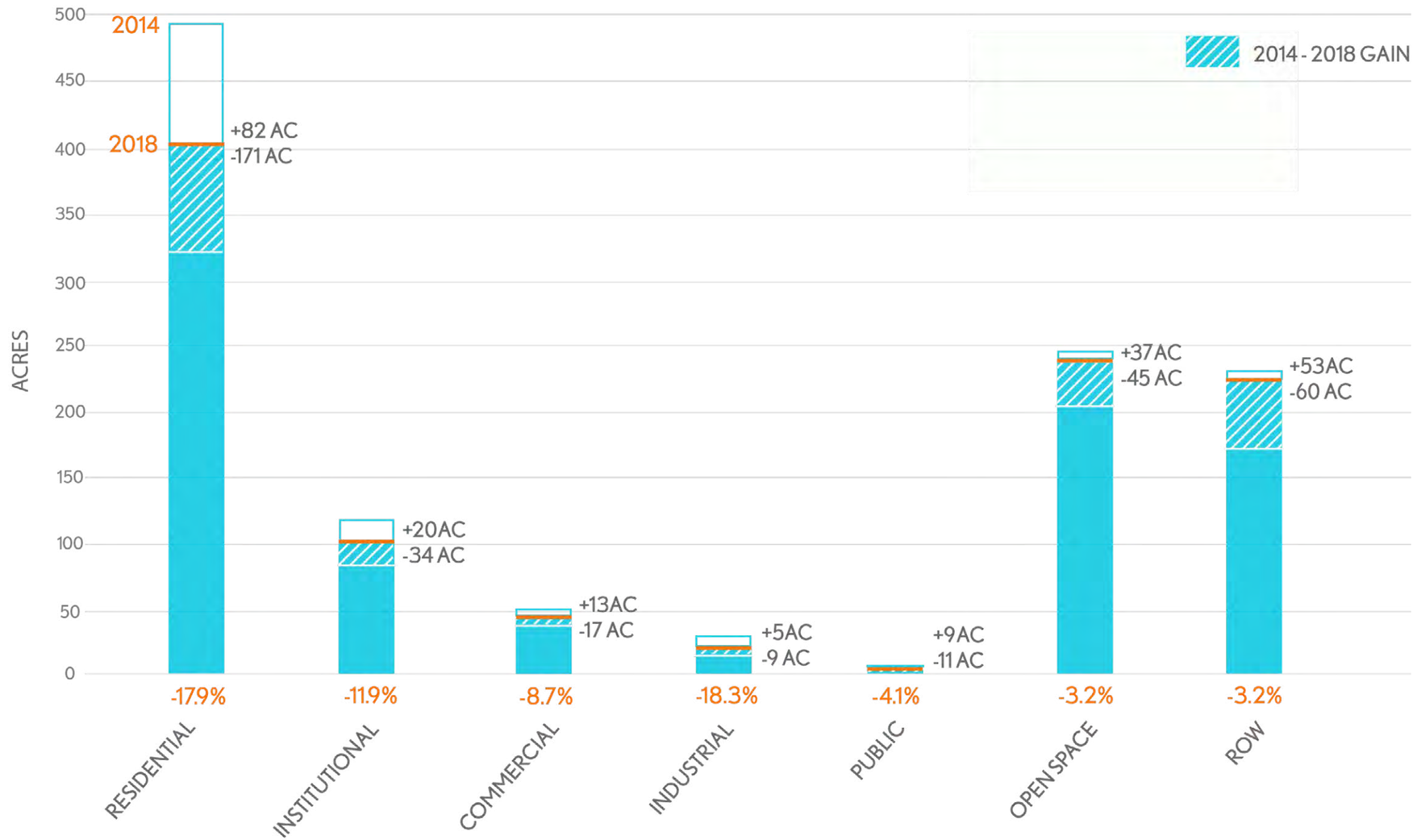
Source: Prepared by RH Team from the 2018 AES classification data.

What are the primary causes of canopy loss?

What will it take to reverse the trend?

Where are the most opportune places to act?

Canopy change by land use



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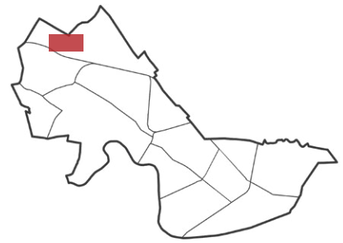
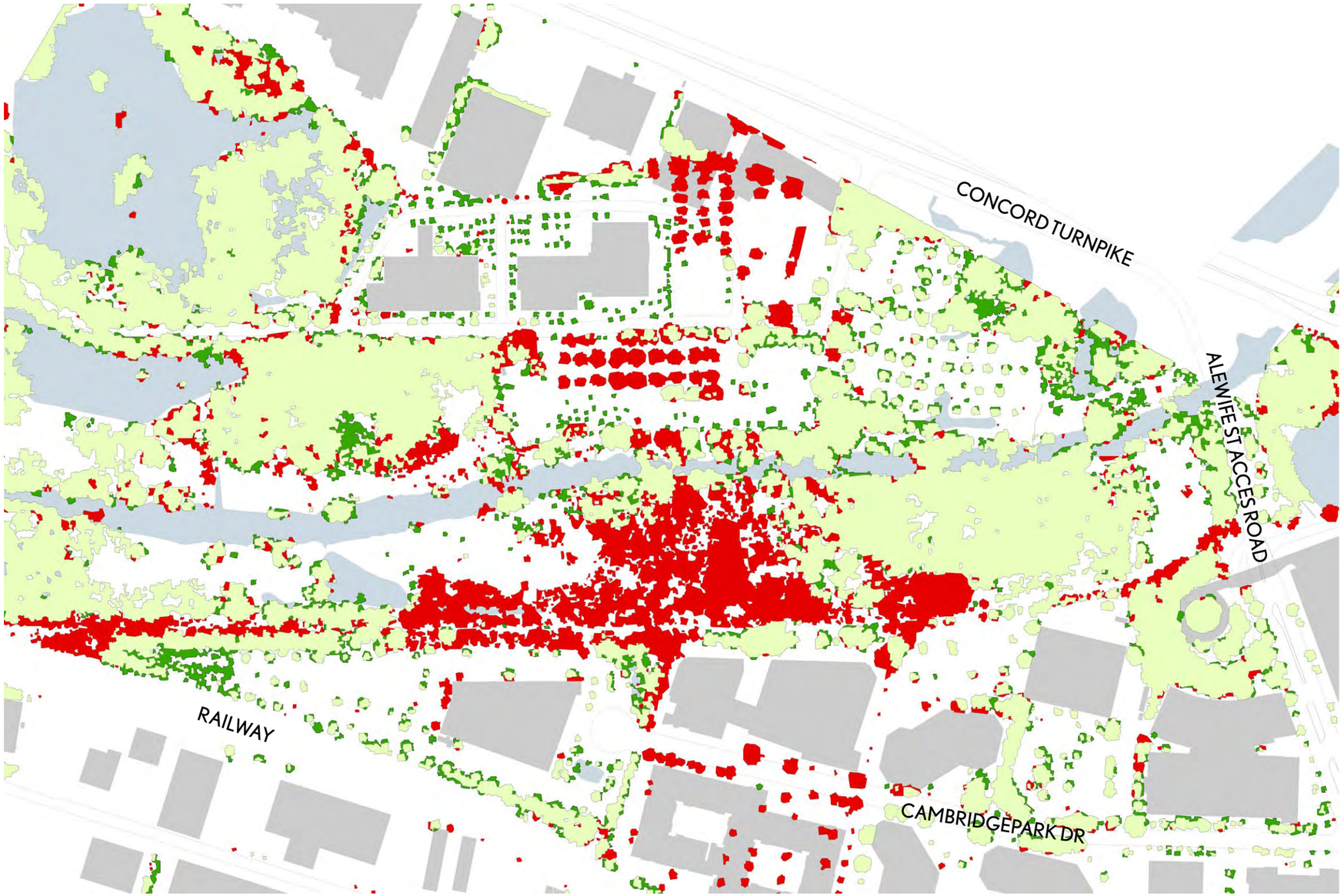
Source: Prepared by RH Team from the 2018 AES classification data and City GIS data.

What were the causes of canopy change?



ALEWIFE 2009-2014



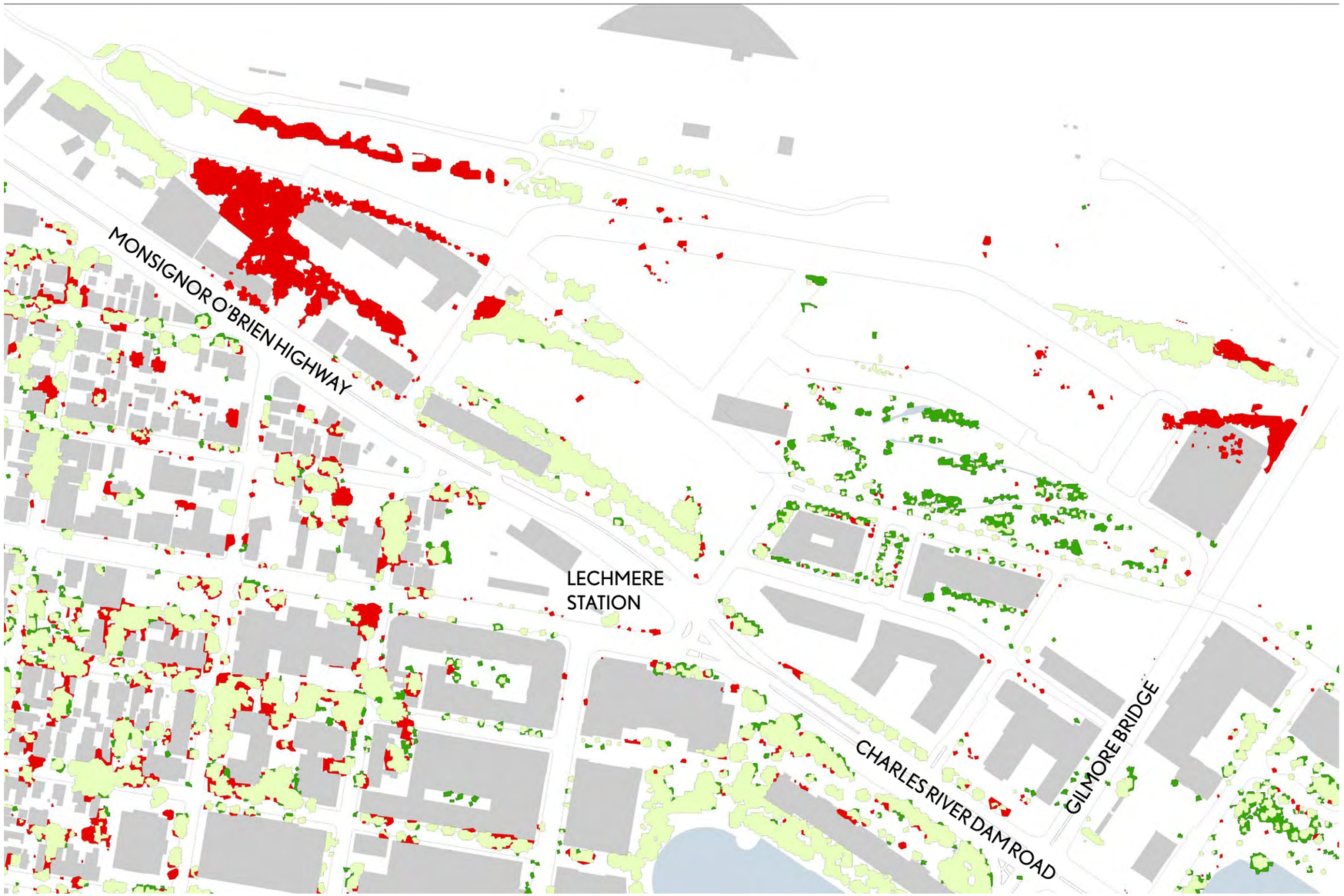
DRAFT

- Area of Canopy Loss
- Area of Canopy Gain
- Area with No Change

Source: Prepared by RH Team from the 2018 AES classification data and City GIS data.

What were the causes of canopy change?

NORTH POINT 2009-2014



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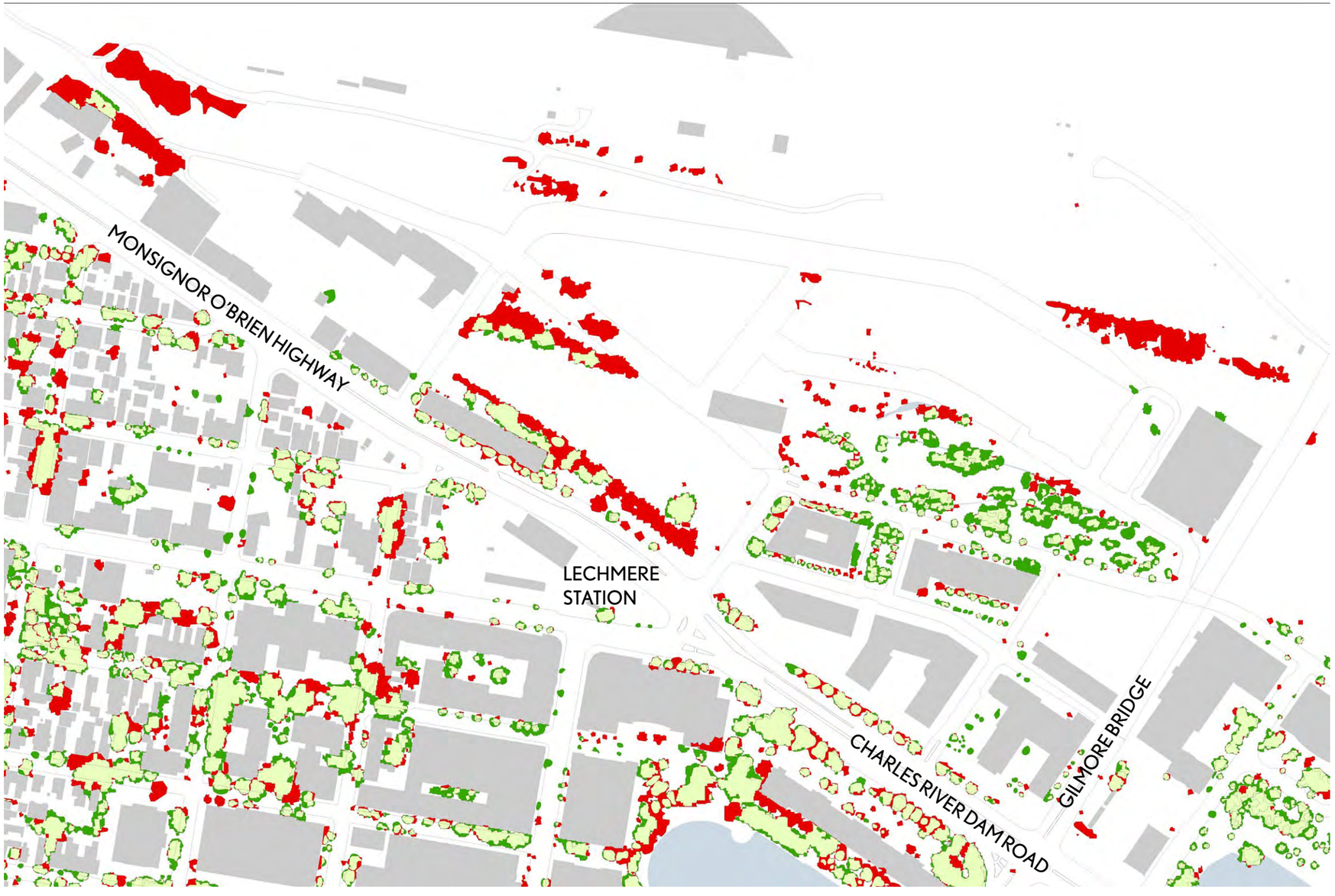
What were the causes of canopy change?

NORTH POINT 2014-2018



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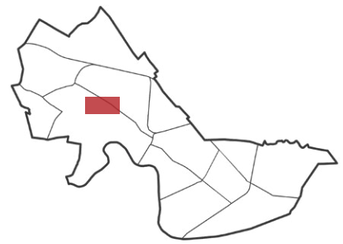
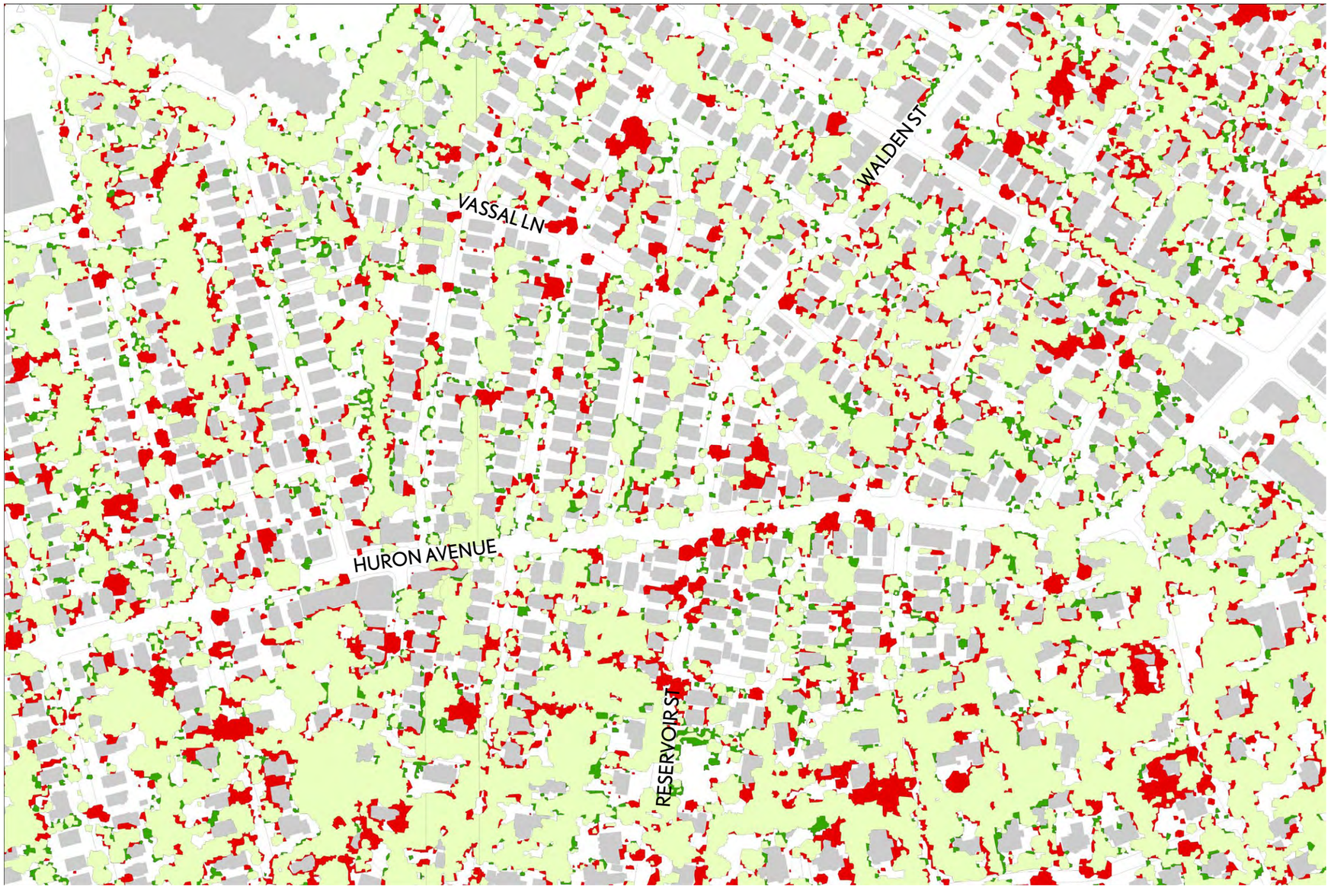


HURON AVE 2014-2018



DRAFT

- Area of Canopy Loss
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- Area with No Change

Source: Prepared by RH Team from the 2018 AES classification data and City GIS data.

What were the causes of canopy change?

CENTRAL SQ 2014-2018

DRAFT

- Area of Canopy Loss
- Area of Canopy Gain
- Area with No Change

Source: Prepared by RH Team from the 2018 AES classification data and City GIS data.

What were the causes of canopy loss?

AGE CLASS	
NEW PLANTING	1.12%
YOUNG	31.6%
SEMI-MATURE	33.3%
MATURE	32.9%
OVERMATURE	0.8%

CONDITION	
GOOD	62.2%
FAIR	25.5%
POOR	7.9%
DEAD	4.2%

TOTAL TREES SURVEYED: 4,118

Source: Bartlett 5% Representative Survey

What should Cambridge set as its goal?

CITY	% COVER FOR THE YEAR CITY'S CANOPY GOAL SET	RECENT CANOPY COVER	GOAL
CAMBRIDGE	N/A	25.3%	TBD
BOSTON	29% (2006)	27% (2017)	49% (2016)
BALTIMORE	20% (2007)	28.5% (2013)	40% (2036)
HARTFORD	25% (2013)	-	35% (ONGOING)
NEW YORK CITY	24% (2006)	20.9% (2013)	36% (2036)
PHILADELPHIA	20% (2011)	20.8% (2013)	30% (2025)

Source: D.J. Nowak et al., Environmental Pollution 178 (2013), 229-236

Leff, Michael, The Sustainable Urban Forest Guide (2016). Davey Institute.

HOW MANY INDIVIDUAL TREES DO WE NEED TO PLANT ?

To offset canopy loss (replace **31 acres** per year)
we need to plant **4,300 3" caliper trees** each year,
and wait 20 years.

— A shade tree that is 3" caliper at planting will have approximately 20 ft spread in 20 years.
— This is not a recommendation and is presented only as a thought experiment.

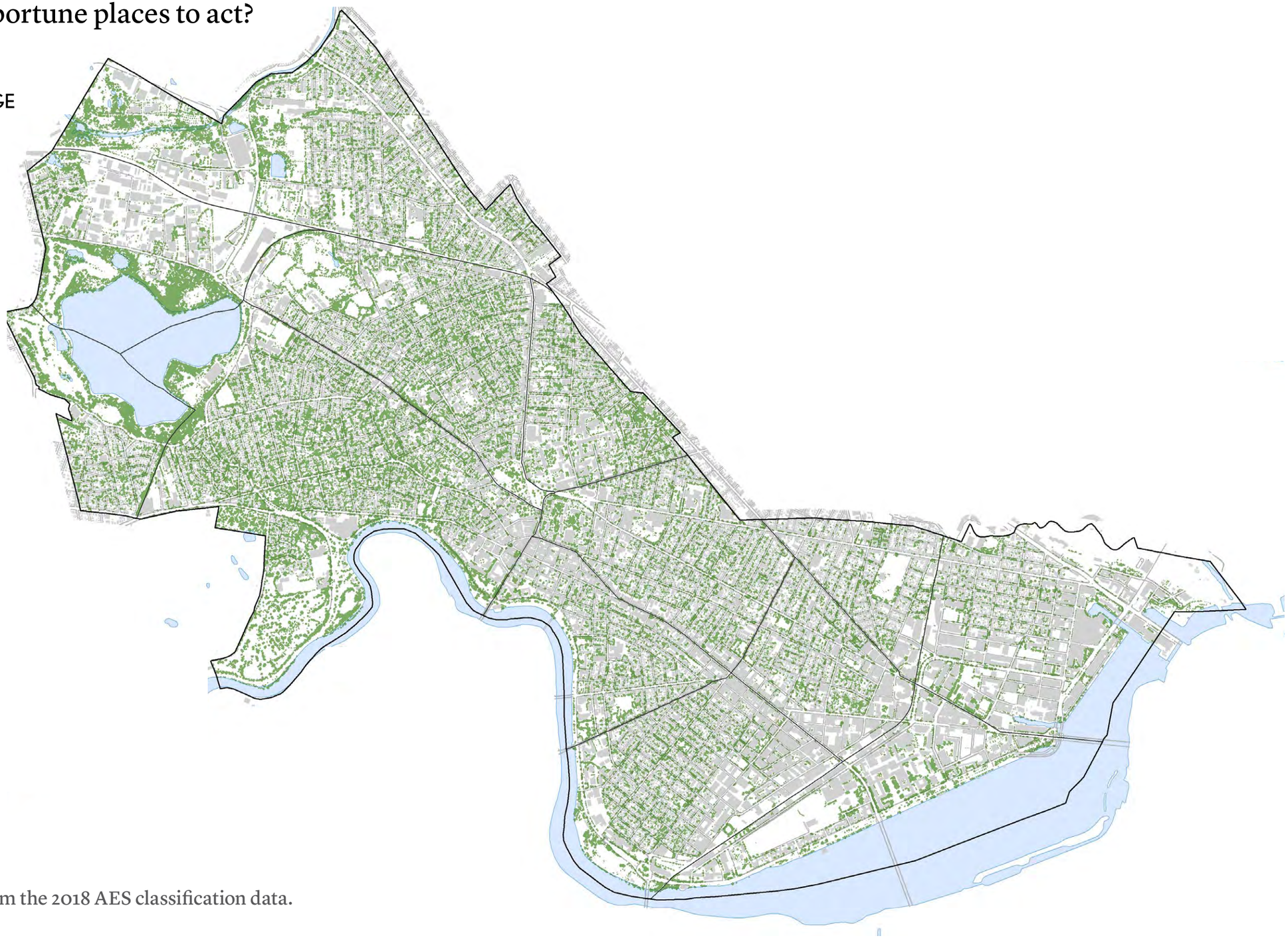
HOW MANY INDIVIDUAL TREES DO WE NEED TO PLANT ?

For a **1% increase** in citywide canopy cover over land area after 20 years (e.g. 25% to 26%), we need to plant **5,633 trees**.

— The total land area of the city is 4,061 acres.
— A shade tree that is 3” caliper at planting will have approximately 20 ft spread in 20 years.
— This is not a recommendation and is presented only as a thought experiment.

Where are the most opportune places to act?

CAMBRIDGE CANOPY COVERAGE
25.3% OF CITY LAND AREA



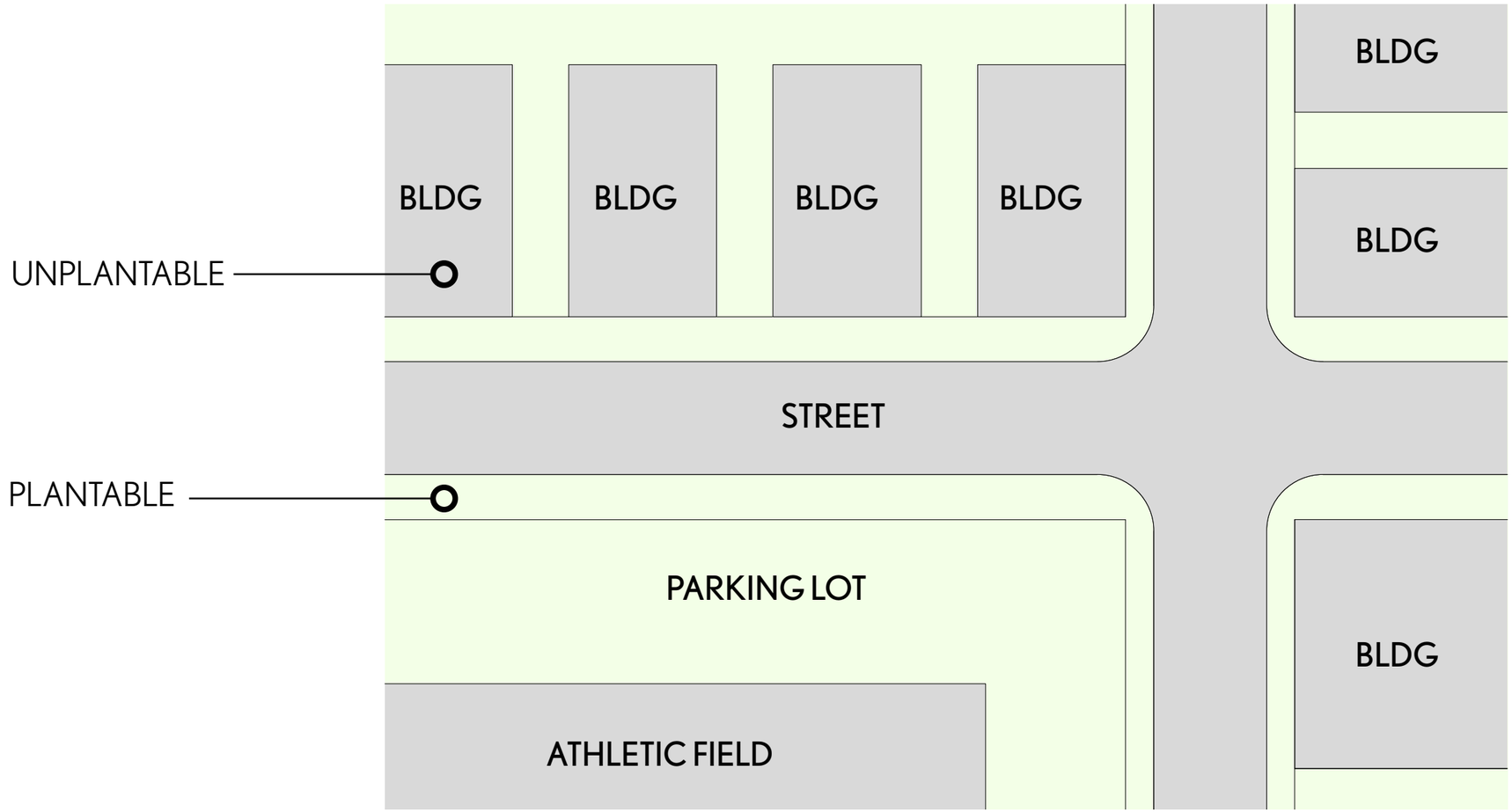
DRAFT

Source: Prepared by RH Team from the 2018 AES classification data.

Where are the most opportune places to act?

HOW MUCH PLANTABLE AREA IS IN THE CITY?

PLANTABLE AREA = TOTAL AREA OF CITY -
(STREETS + BUILDINGS + WATER + ATHLETIC FIELDS)



Grouping of Land Use Categories

COMMERCIAL

MIXED USE COMMERCIAL
OFFICE
OFFICE/R&D
PRIVATELY-OWNED OPEN SPACE
VACANT COMMERCIAL

OPEN SPACE

CEMETERY
PUBLIC OPEN SPACE

INDUSTRIAL

MIXED USE INDUSTRIAL
UTILITY
VACANT INDUSTRIAL

INSTITUTIONAL

CHARITABLE/RELIGIOUS
EDUCATION RESIDENTIAL
HEALTH
HIGHER EDUCATION
MIXED-USE EDUCATION

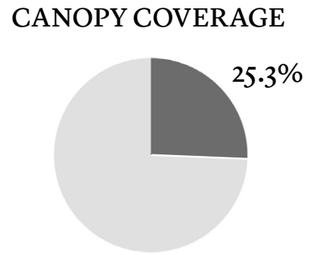
PUBLIC

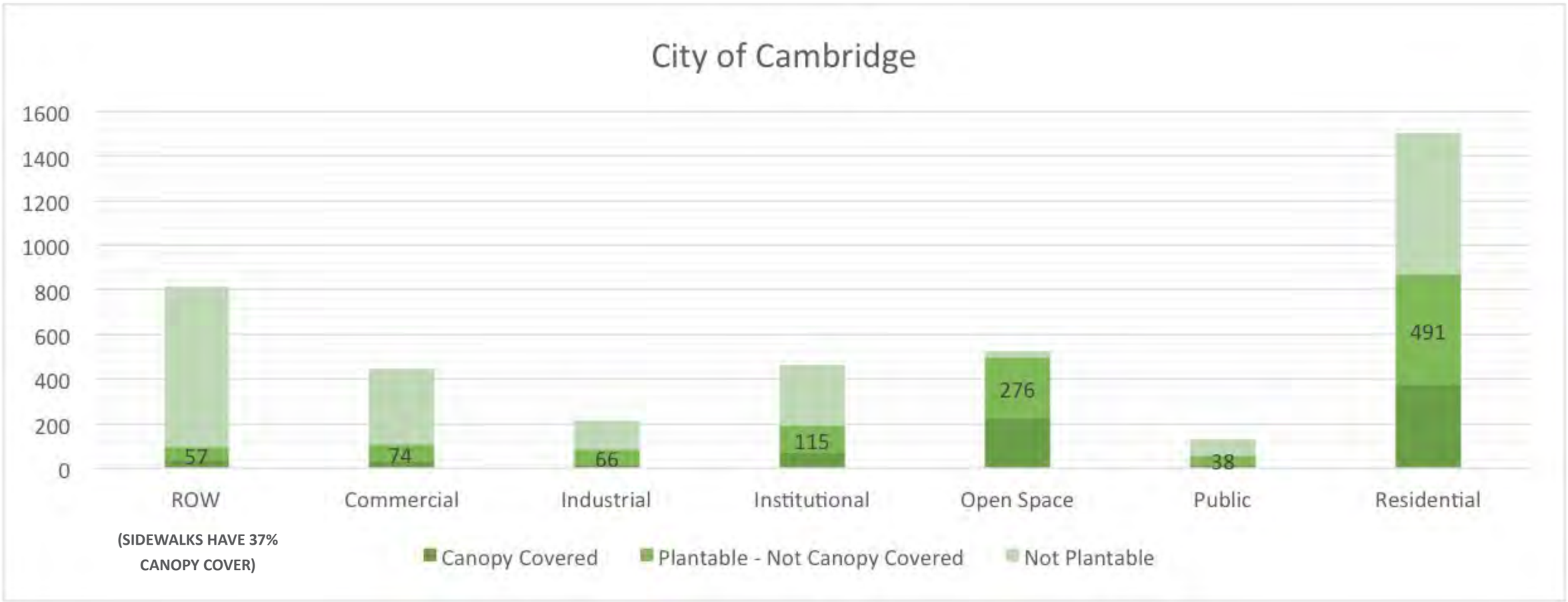
EDUCATION
GOVERNMENT OPERATIONS

RESIDENTIAL

ASSISTED LIVING/BOARDING
MIXED USE RESIDENTIAL
VACANT RESIDENTIAL

Where are the most opportune places to act?

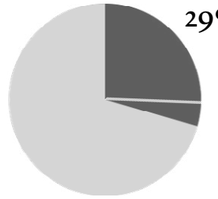


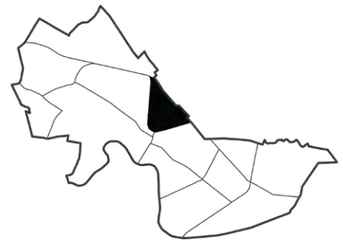


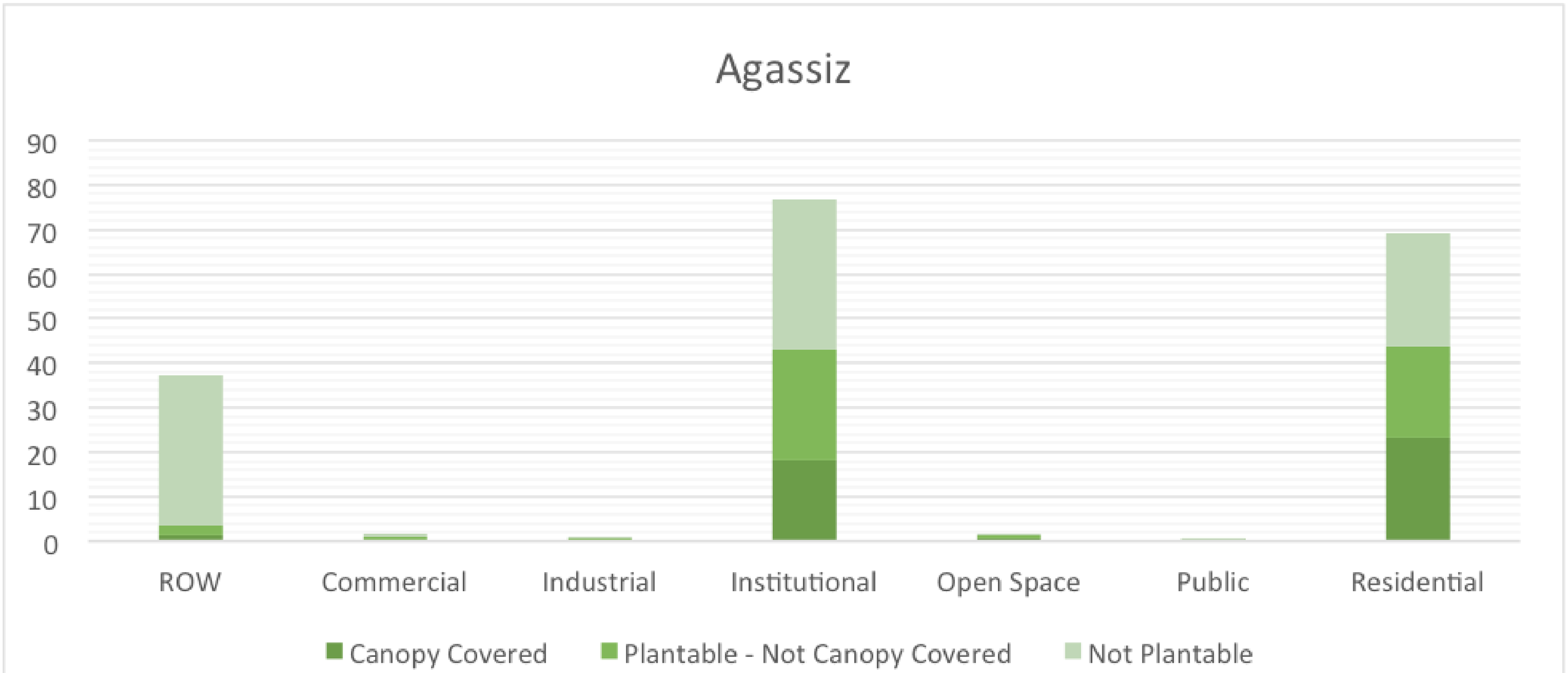
DRAFT

Source: Prepared by RH Team from the 2018 AES classification data and City GIS data.

Plantable area by neighborhood







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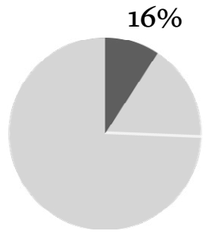

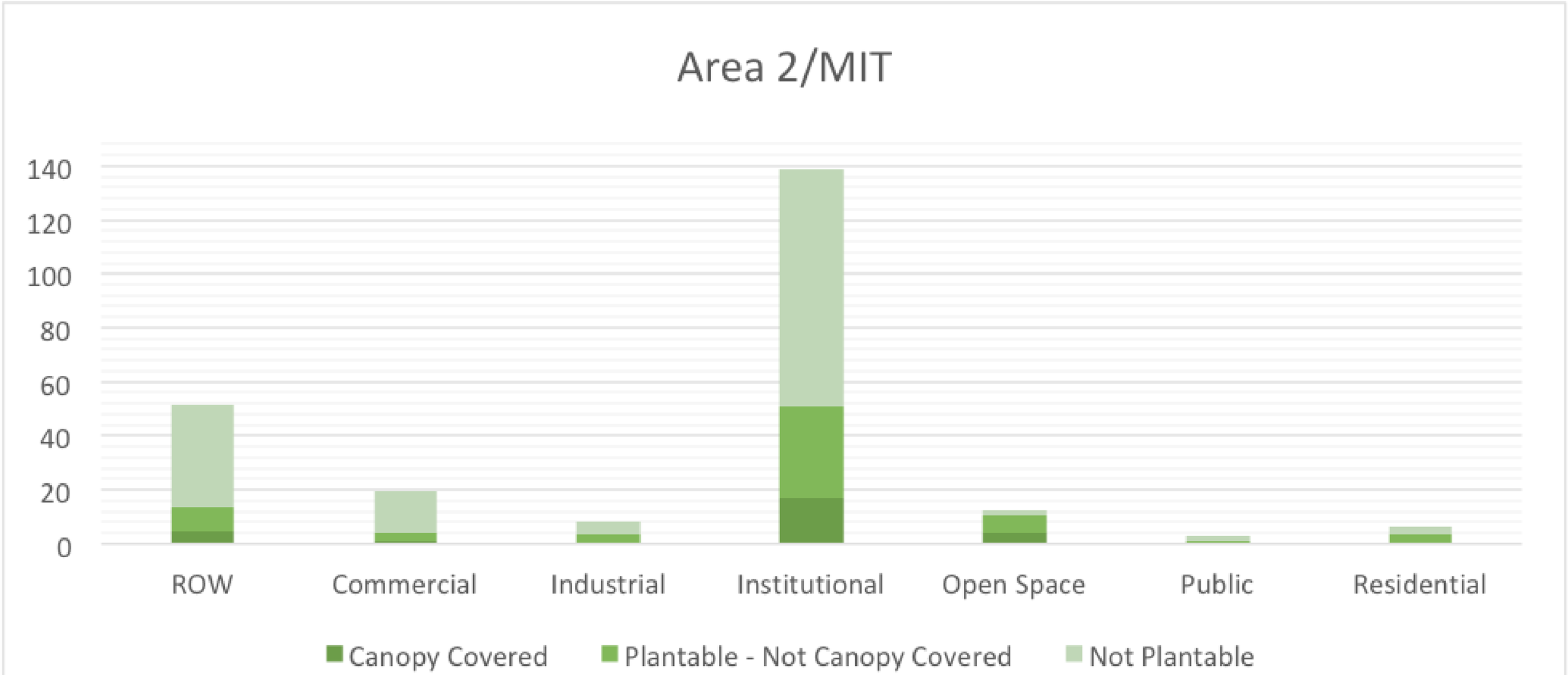

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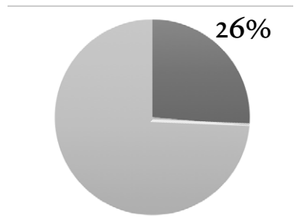

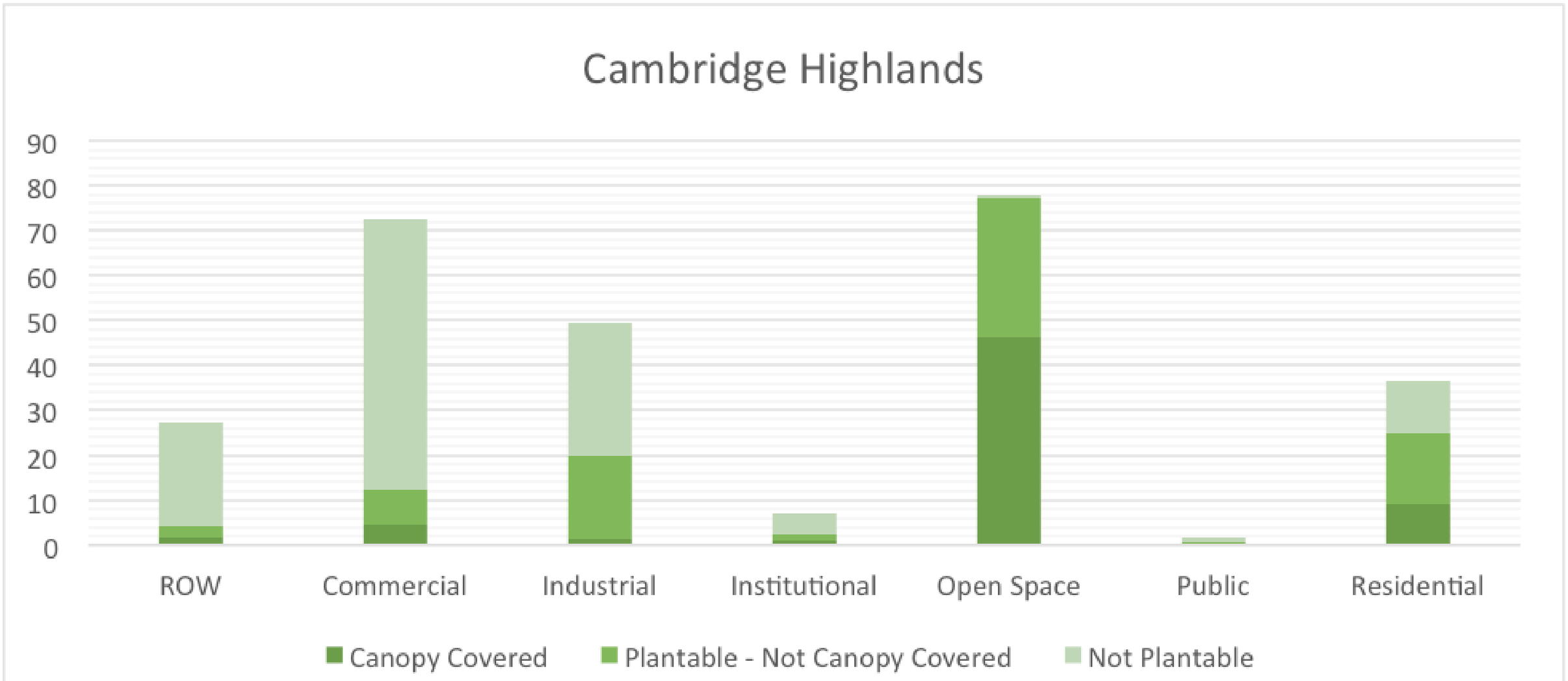

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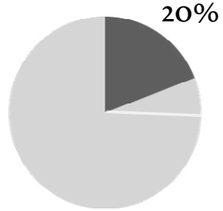

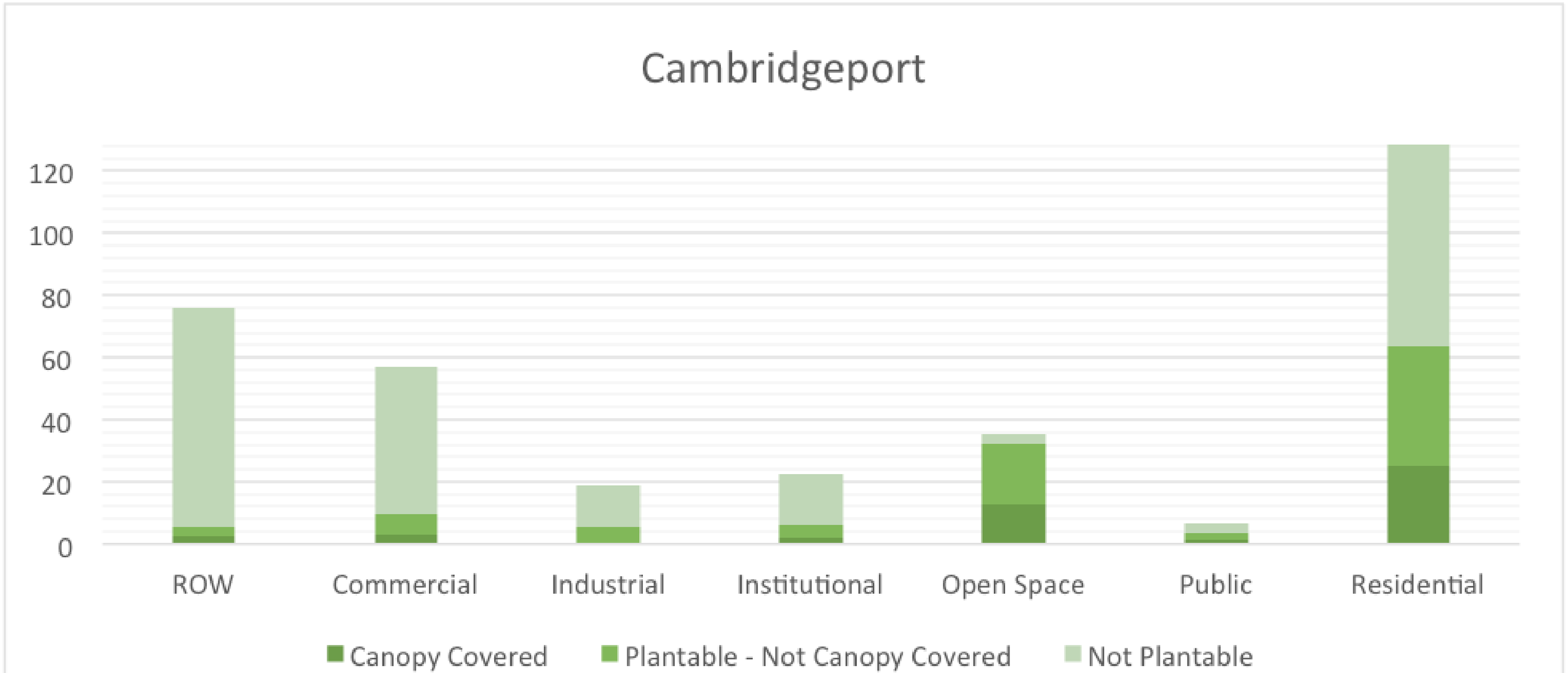

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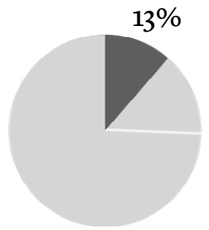

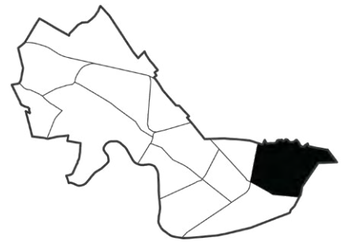

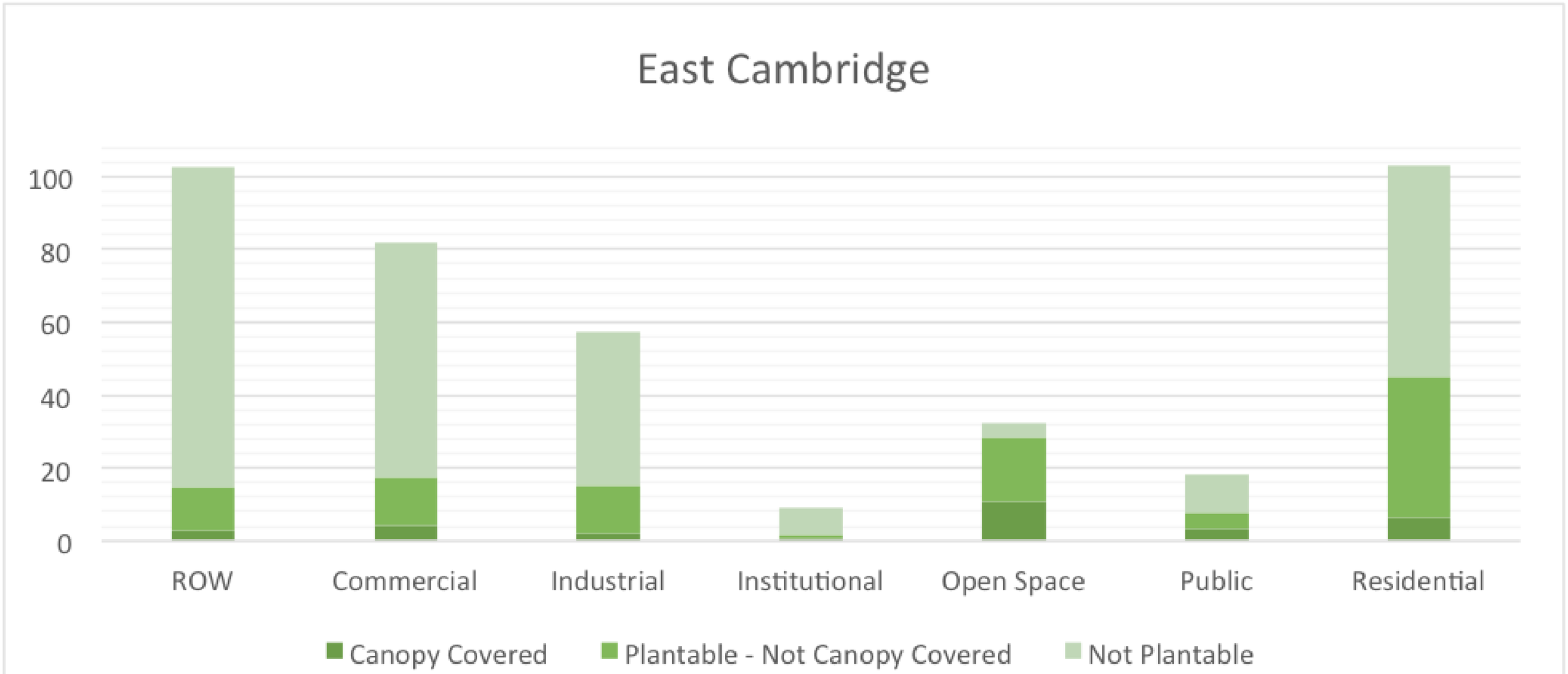

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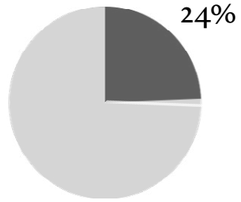

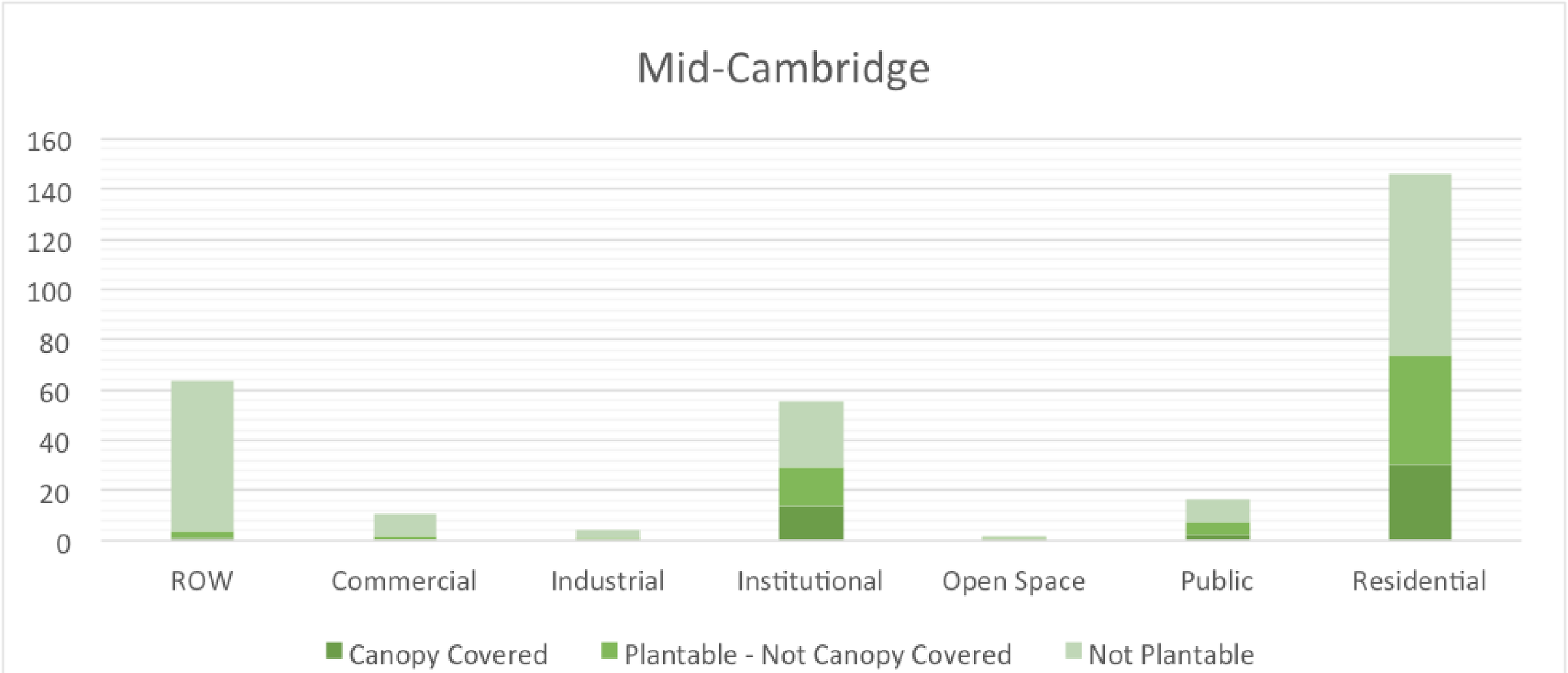

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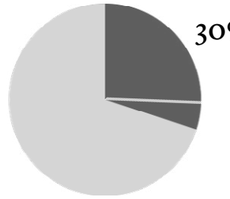

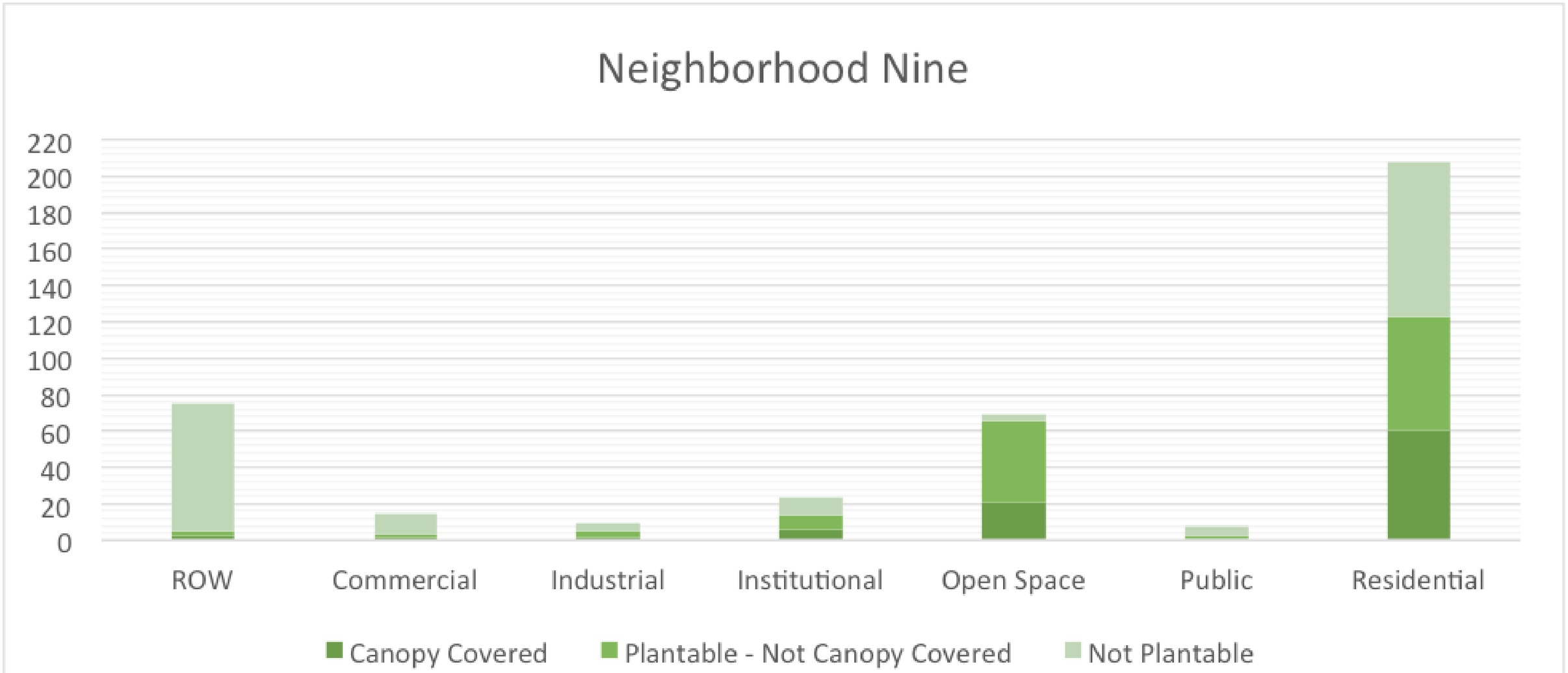

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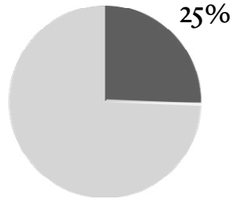

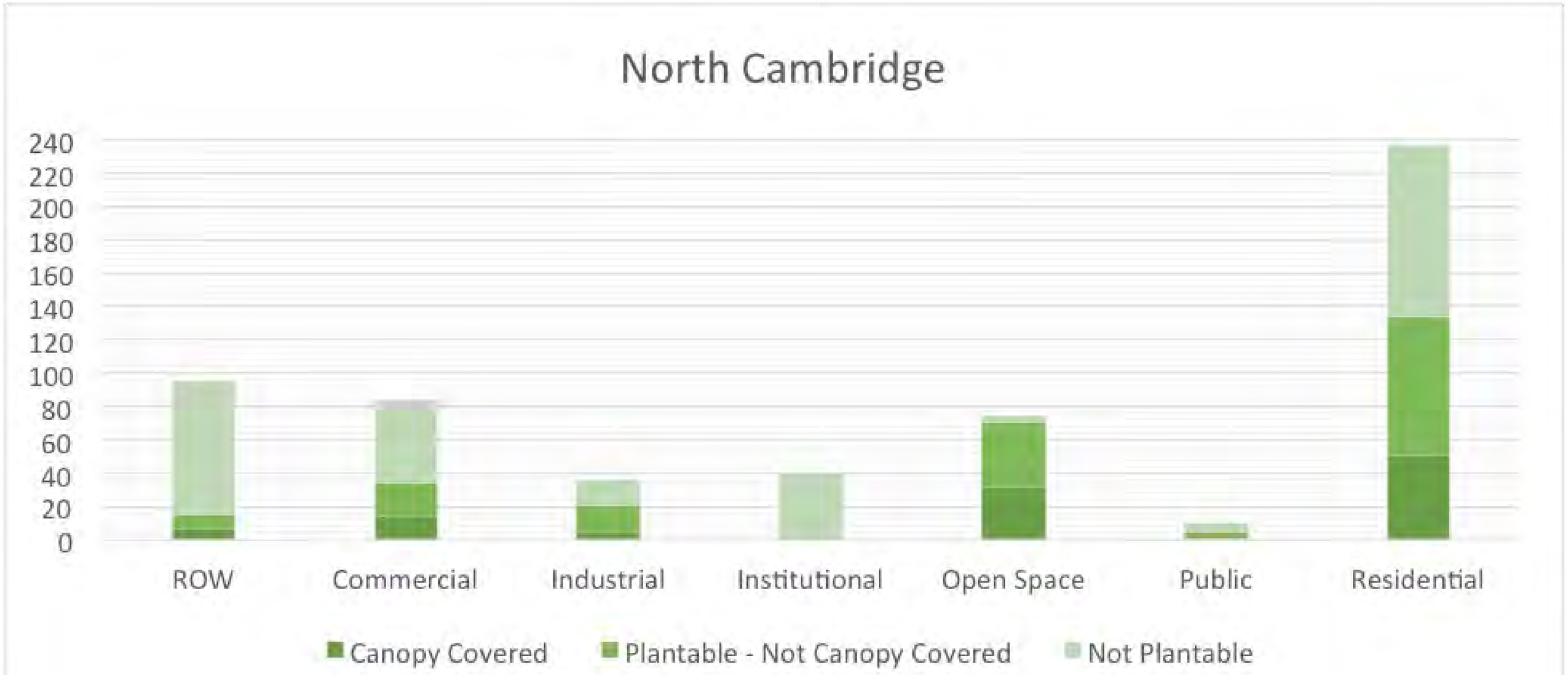

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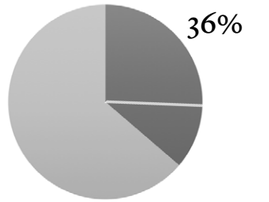

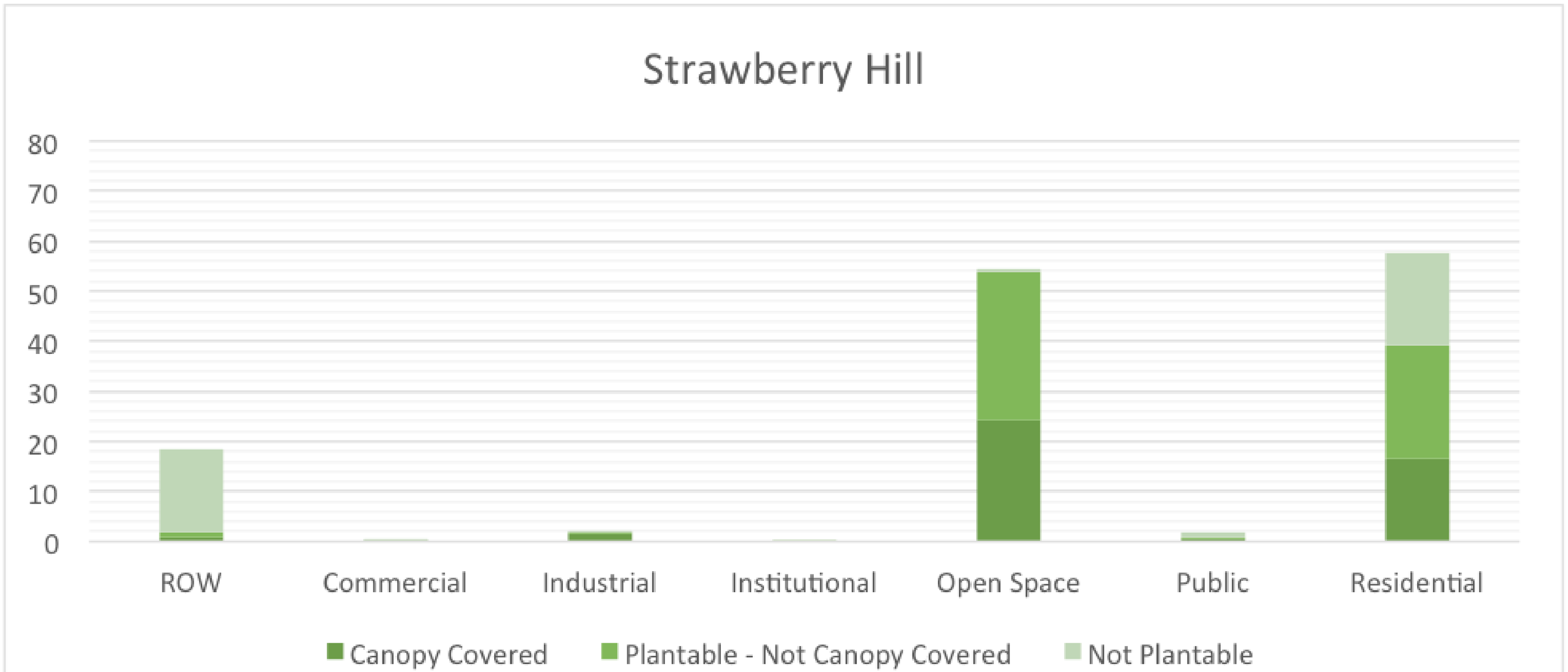

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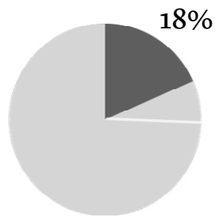

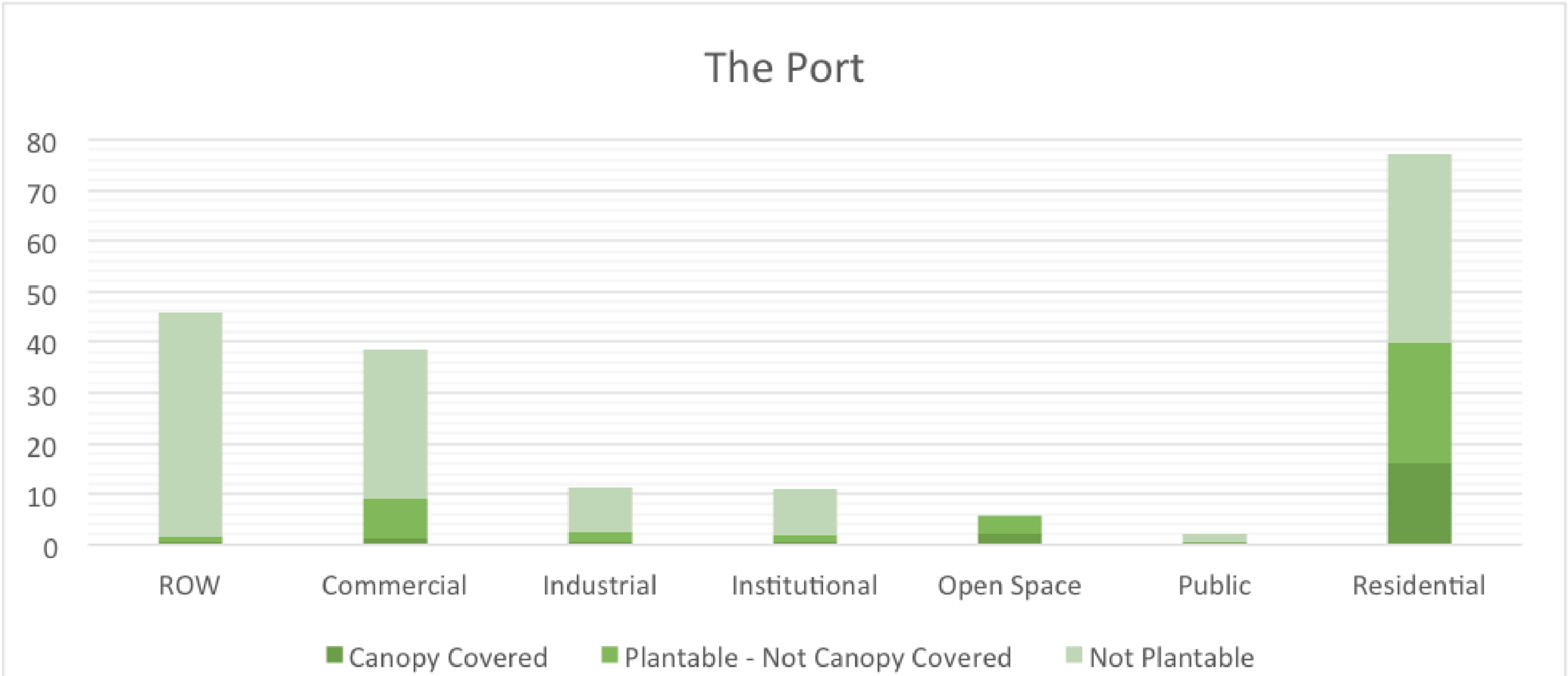

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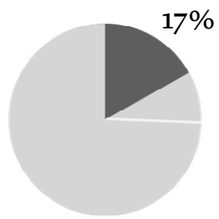

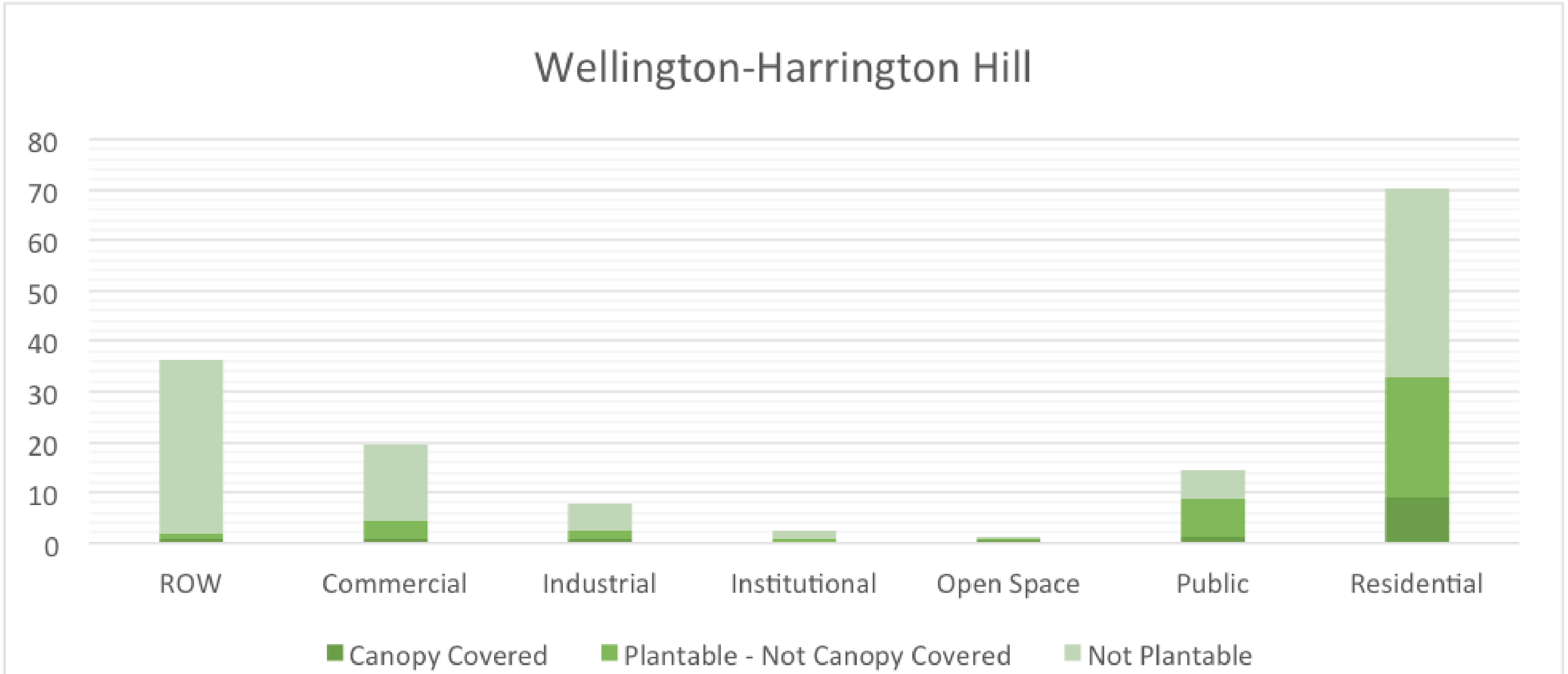

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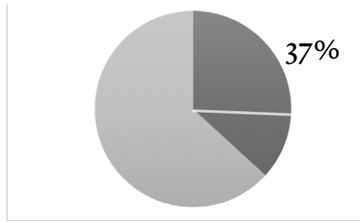

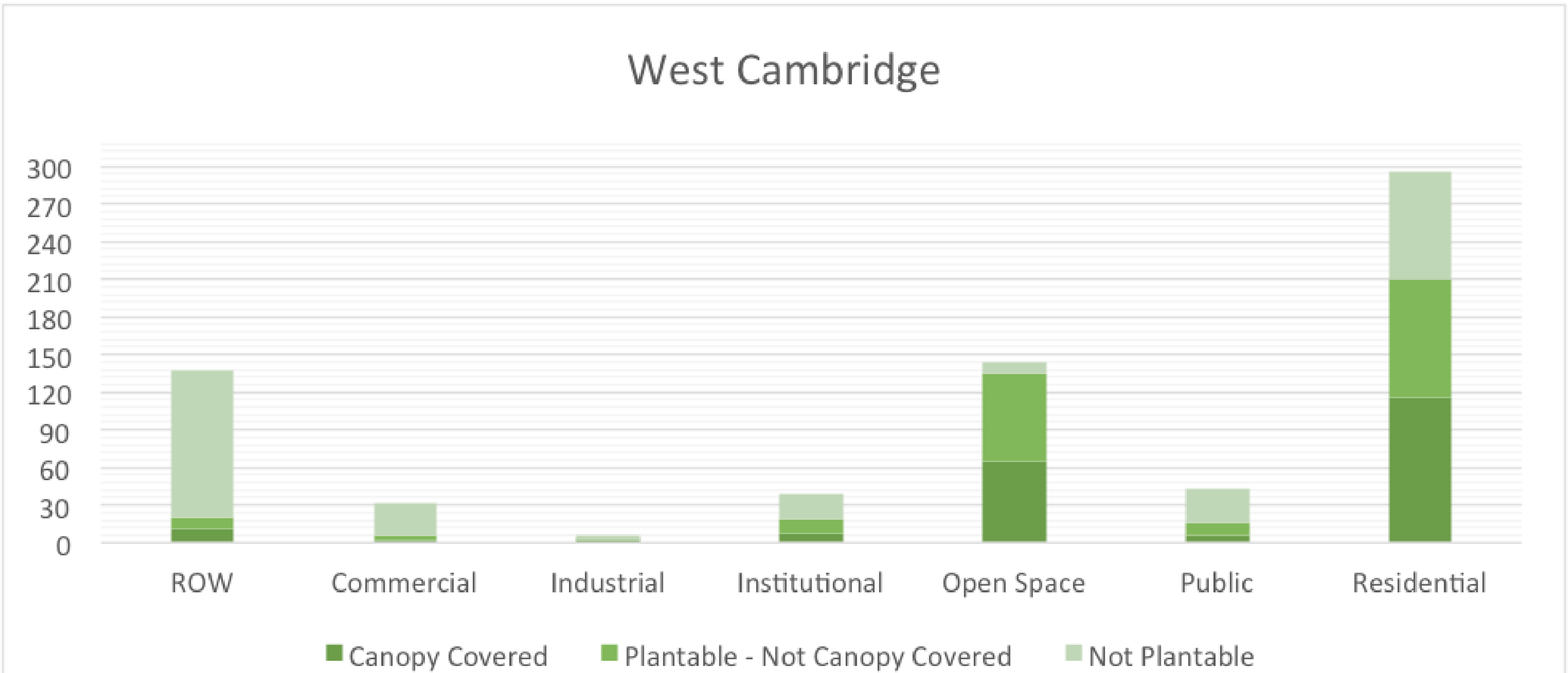

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Source: Prepared by RH Team from the 2018 AES classification data and City GIS data.

OBSERVATIONS & DISCUSSION

– CANOPY COVER
– SPECIES DIVERSITY
– CANOPY EQUITY
– HUMAN EXPERIENCE

PUBLIC COMMENT

Today, **3 species** make up over **30%** of the Cambridge forest.

Catastrophic loss of those 3 species would result in **17% remaining** total canopy cover.

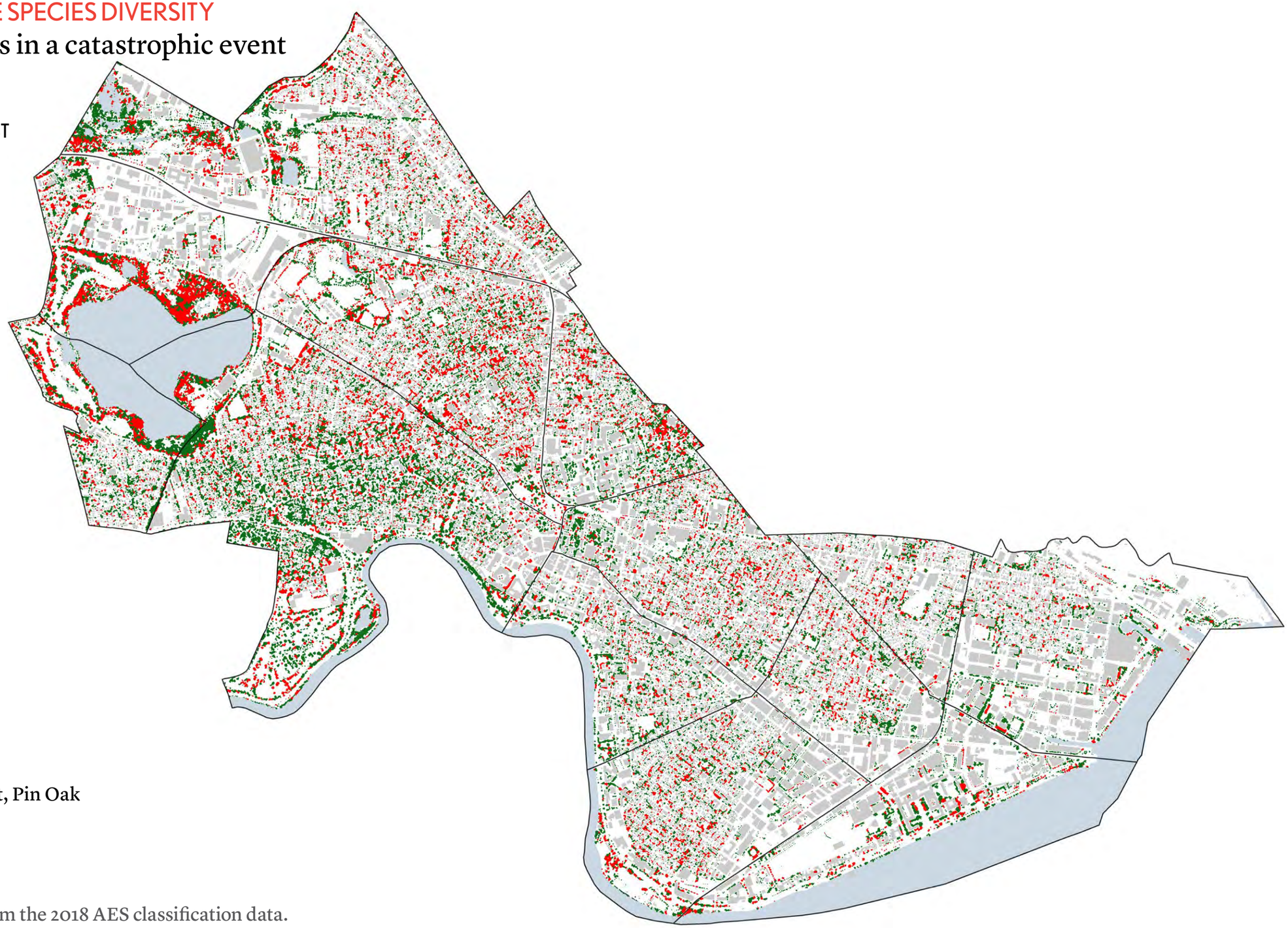
Other	36.4%
Norway Maple	12.5%
Pin Oak	11 %
Honey locust	9.2%
Red Maple	6.8%
Red Oak	6%
Littleaf Linden	4.2%
Callery Pear	3.9%
London Planetree	3.6%
Ash	3.4%
Crabapple	2.5%

DRAFT

Source: Prepared by RH Team according to the 2018 AES classification data.

Loss of top three species in a catastrophic event

NORWAY MAPLE, HONEY LOCUST
AND PIN OAK COMPOSE
32.7% OF THE URBAN FOREST



Norway Maple, Honey Locust, Pin Oak

Remaining Canopy

DRAFT

Source: Prepared by RH Team from the 2018 AES classification data.

DISCUSSION

What diversity targets should Cambridge set?

And how can the city best achieve that goal?

Suggested diversity target

5%	10%	20%
SPECIES	GENUS	FAMILY

Santamour, 1990: Urban foresters and municipal arborists should use the following guidelines for tree diversity within their areas of jurisdiction:

(1) plant no more than 10% of any species,

(2) no more than 20 % of any genus,

(3) no more than 30 % of any family.

Melbourne Urban Forest Diversity Guidelines, 2011: The urban Forest Diversity Guidelines recommend that by 2040

(1) no more than 5 percent of the forest is to be of any single species,

(2) no more than 10 percent is to be of any one genus,

(3) no more than 20 percent is to be of any one Family.

Other	36.4%	
Norway Maple	12.5%	Above 5% per species
Pin Oak	11 %	
Honey locust	9.2%	
Red Maple	6.8%	
Red Oak	6%	Above 10% per genus
Littleaf Linden	4.2%	
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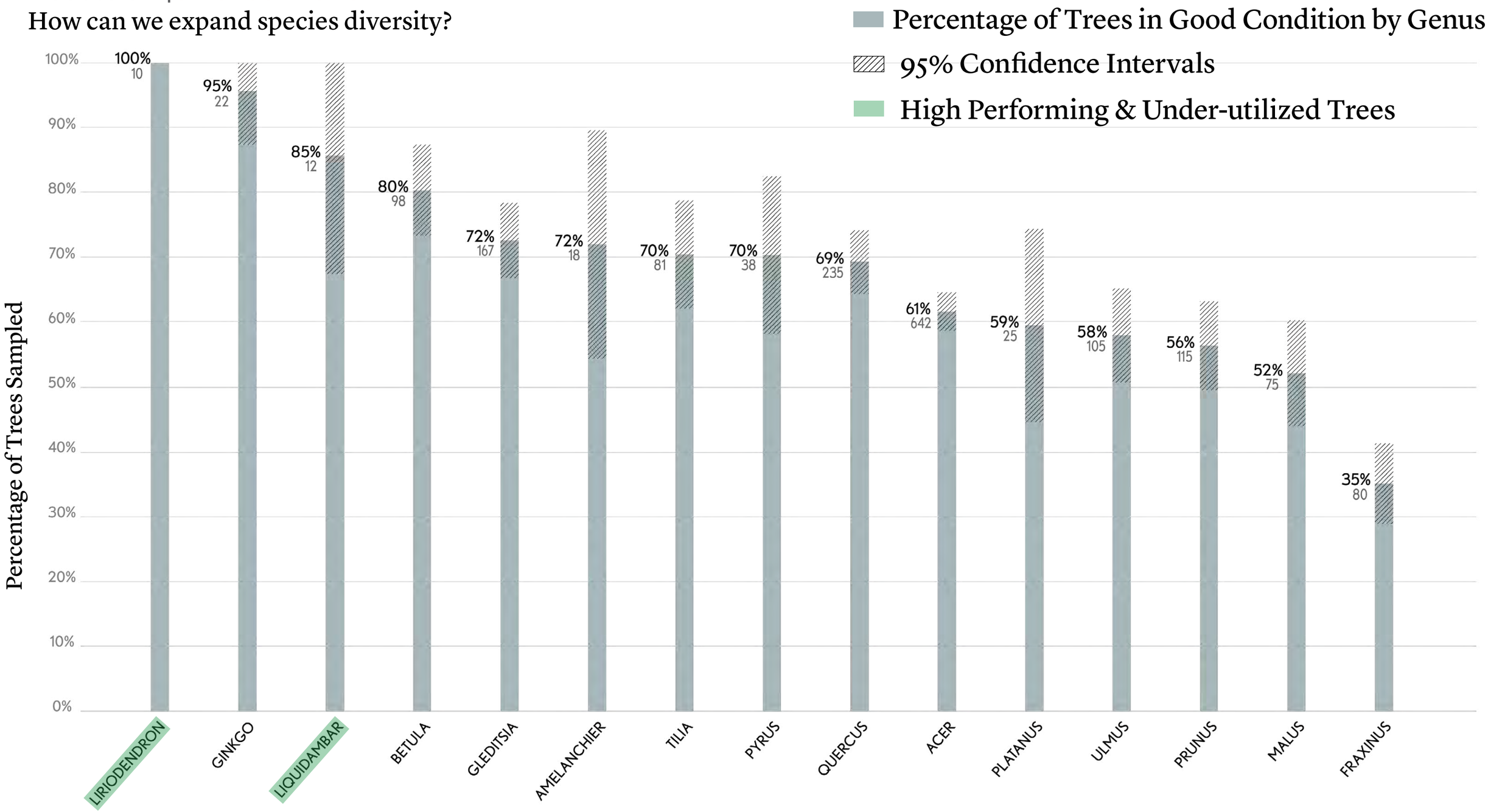
London Planetree	3.6%	
Ash	3.4%	
Crabapple	2.5%	

DRAFT

Source: Prepared by RH Team according to the 2018 AES classification data.

How can we expand species diversity?



Source: Prepared by RH Team according to Bartlett 5% Representative Tree Inventory .

How should the city's recommendations change?

Ornamental Tree (overhead wires present)	Height (feet)
Amur maackia (Maackia amurensis)	20-30
Accolade cherry (Prunus 'Accolade')	20
Akebono cherry (Prunus x yedoensis 'Akebono')	25
Autumn cherry (Prunus subhirtella 'Autumnalis')	25-40
Crabapple spp (Malus sp.)	15-25
Eastern redbud (Cercis canadensis)	20-30
Hedge Maple (Acer campestre)	25-30
Japanese tree lilac (Syringa reticulata)	20-30
Kwanzan cherry (Prunus serrulata 'Kwanzan')	25
Okame cherry (Prunus x incam 'Okame')	15-25
Paperbark maple (Acer griseum)	30
Sargent cherry (Prunus sargentii)	25-40
Serviceberry (Amelanchier sp.)	20-30
Snowgoose cherry (Prunus serrulata 'Snowgoose')	20

Trees with low condition ratings

Trees that exceed diversity target

Shade Tree (no wires present)	Height (feet)
American elm (Ulmus americana)	50-70
Armstrong Red maple (Acer x freemanii)	50-70
Black oak (Quercus velutina)	50-60
Black tupelo (Nyssa sylvatica)	30-50
Dawn redwood (Metasequoia glyptostroboides)	75
Elm cultivars (Ulmus sp.)	40-60
Ginkgo (Gingko biloba)	40-80
Golden raintree (Koelreuteria paniculata)	30-40
Hackberry (Celtis occidentalis)	60
Honeylocust (Gleditsia triacanthos)	45-50
Hornbeam (Carpinus caroliniana)	35
Katsuratree (Cercidiphyllum japonicum)	50
Kentucky coffeetree (Gymnocladus dioicus)	75
Littleleaf linden (Tilia cordata)	45-60
London planetree (Platanus x acerifolia)	80
Pear spp (Pyrus sp.)	30-40
Pin oak (Quercus palustris)	75
Red maple (Acer rubrum)	40-70
Red oak (Quercus rubra)	75
River birch (Betula nigra)	50-70
Silver linden (Tilia tormentosa)	30-40
Sophora (Sophora (Styphnolobium) japonica)	50
Swamp White oak (Quercus bicolor)	45
Sweetgum (Liquidambar styraciflua)	65
Tuliptree (Liriodendron tulipifera)	70-90
Zelkova (Zelkova serrata)	50-70

OBSERVATIONS & DISCUSSION

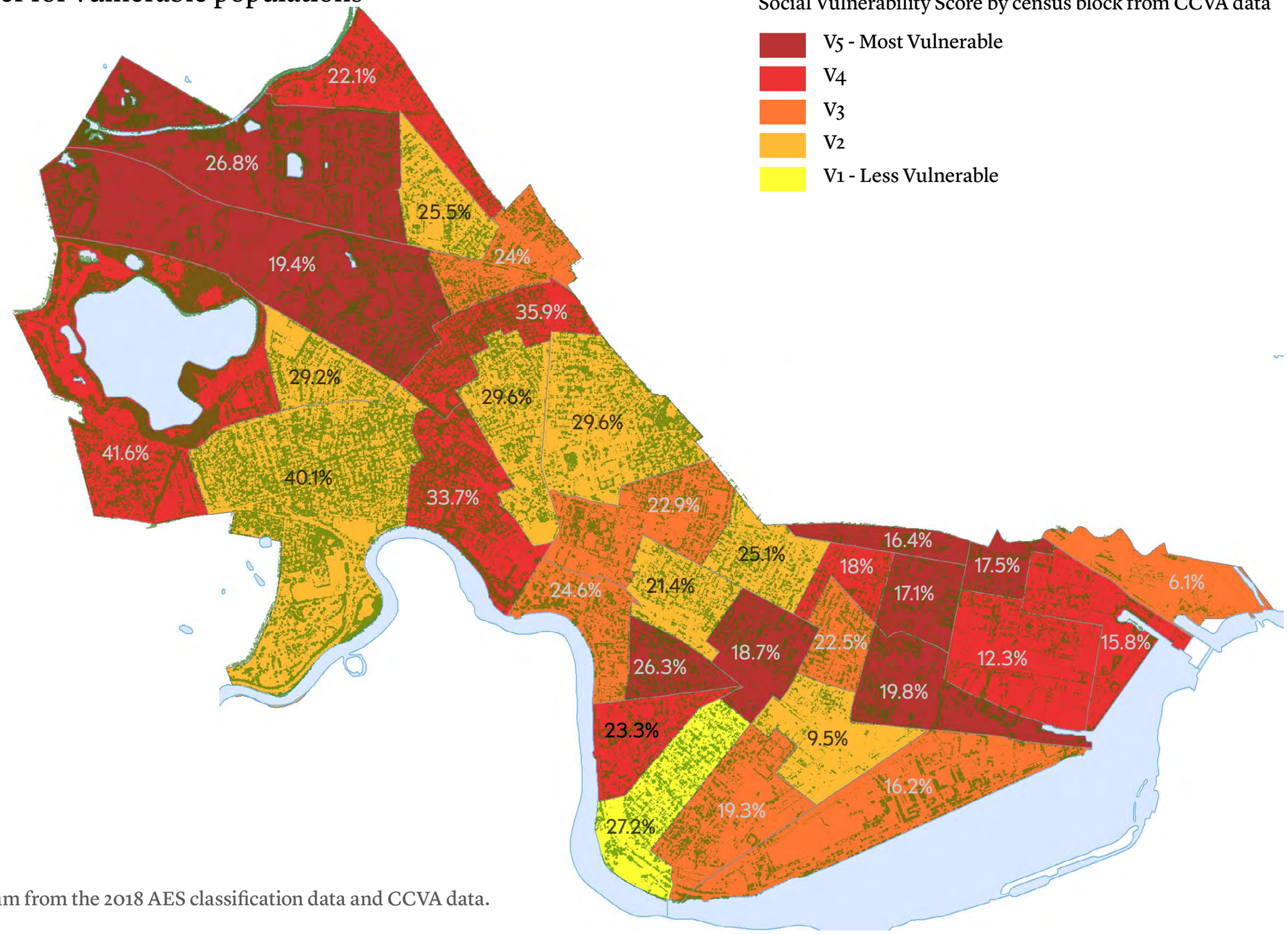
– CANOPY COVER
– SPECIES DIVERSITY
– CANOPY EQUITY
– HUMAN EXPERIENCE

PUBLIC COMMENT

More vulnerable populations tend to live in areas of Cambridge with **less canopy** cover.

Density, urban form, and land use tend to limit opportunities for tree planting in these neighborhoods.

Percent canopy cover for vulnerable populations



Social Vulnerability Score by census block from CCVA data

- V5 - Most Vulnerable
- V4
- V3
- V2
- V1 - Less Vulnerable

DRAFT

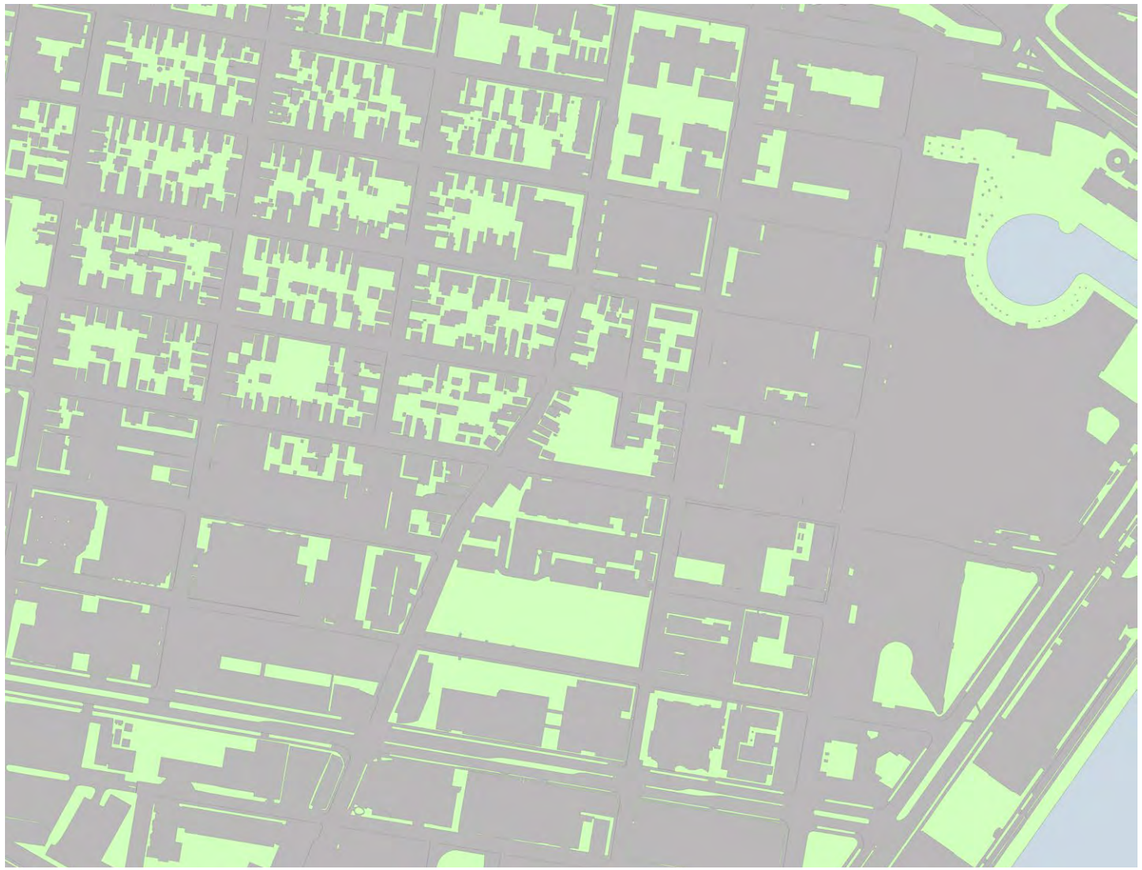
Source: Prepared by RH Team from the 2018 AES classification data and CCVA data.

What can Cambridge do to reverse the canopy deficit in vulnerable communities?

Plantable area and vulnerable populations

Non-plantable area

Plantable area



DRAFT

Source: Prepared by RH Team from the 2018 AES classification data and CCVA data.

OBSERVATIONS & DISCUSSION

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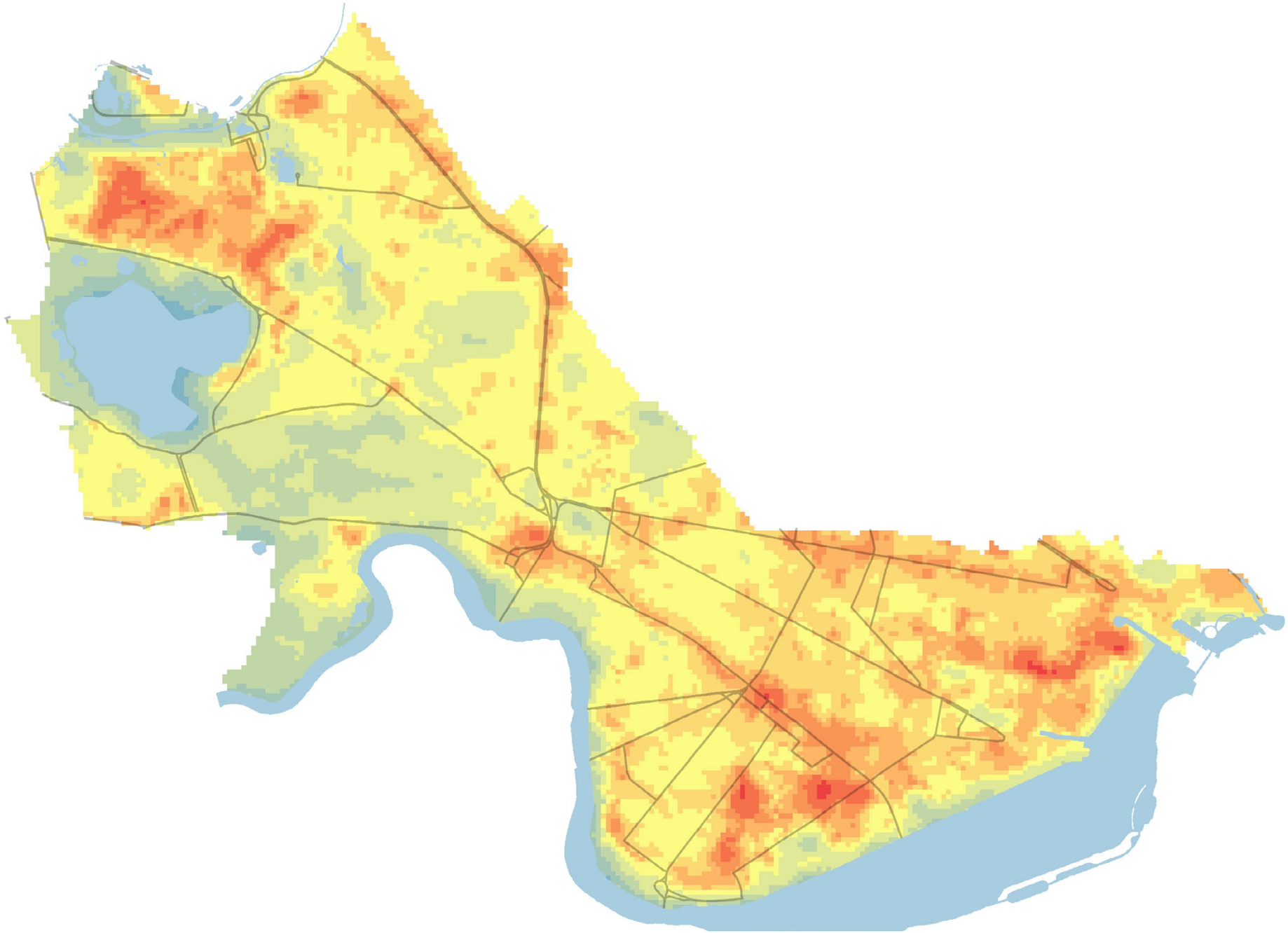
PUBLIC COMMENT

Lack of shade, resulting in **heat island** effect, is often aligned with primary pedestrian corridors and commercial centers (squares).

As summer temperatures rise, developing connective corridors of shade (**cool corridors**) will be increasingly important.

Heat island + bus routes (cool corridors)



ESTIMATED AMBIENT AIR TEMPERATURE OF A 100 °F DAY IN 2070

- 86.6 - 87.5
- 87.5 - 90
- 90 - 92.5
- 92.5 - 95
- 95 - 97.5
- 97.5 - 100
- 100 - 102.5
- 102.5 - 105
- 105 - 107.5
- 107.5 - 110
- 110 - 112.5

Source: CCVA

2070 Urban Heat Island

Where should the city focus resources in order to most effectively enhance human comfort?

Where street trees can't be planted in ideal conditions, are there alternative strategies?

Heat island + cool corridors

PROJECT GOALS
DRAFT Decision support framework

Vision	Goals		Evaluative Criteria	Baseline	2030 Target	2070 Target
To build, maintain, and sustain a healthy, connective urban forest at a time when the urban forest is more important than ever before.	PEOPLE: A forest that contributes to residents' well-being and residents who contribute to the forest well-being	Enhance shading and cooling				
		Improve pedestrian thermal comfort	Ambient sidewalk temperatures, Connectivity			
		Reduce urban heat island effects	Degrees relative to city avg			
		Increase equity in distribution of canopy cover	Canopy cover by vulnerable population			
		Create pleasing environments	Well-being / stress levels (survey)			
		Increase residents' awareness of value of trees	Engagement, program adoption (survey)			
		Enhance citywide stormwater management	Rainfall interception			
		Increase carbon sequestration	Carbon capture rates			
	TREES: A healthy forest whose trees live longer and thrive during predicted changing climate conditions	Improve soils health	Soil quality index			
		Improve tree health	% trees in good health			
		Improve street tree lifespan	Avg life of street tree			
	FOREST: A forest that supports a resilient, connected ecosystem	Enhance habitat	Canopy connectivity, species census			
		Diversify forest composition	City diversity index			
		Improve disaster response (noreaster, drought)	Projected impact and recovery rates			

OBSERVATIONS & DISCUSSION

– CANOPY COVER
– SPECIES DIVERSITY
– CANOPY EQUITY
– HUMAN EXPERIENCE

PUBLIC COMMENT

PUBLIC MEETING COMING UP ON OCT 3

PRESENTATION OF RESEARCH: SUMMARY OF FINDINGS

TASK FORCE MEETING SCHEDULE

JUNE 12	Introduction
JUNE 28	RESEARCH: Regulation and Management
JULY 26	RESEARCH: Goal Setting
AUGUST 30	RESEARCH: Ongoing Analysis + Climate Modeling
SEPTEMBER 27	RESEARCH: Summary of Findings
OCTOBER 25	TESTING: Baseline Change Model
NOVEMBER 29	TESTING: Impact Analysis
DECEMBER 20	PROPOSAL DEVELOPMENT
JANUARY 31	PROPOSAL DEVELOPMENT
FEBRUARY 28	DRAFT DOCUMENTATION
MARCH 28	DRAFT DOCUMENTATION
APRIL 25	DRAFT DOCUMENTATION

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