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Urban tree canopy, green spaces and built environment data analysis and reporting 2022

Survey Area
Technical Report
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Prepared for

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Contents

Abbreviations

AI/ML – Artificial intelligence / machine learning
CHM – Canopy height model
LGA – Local government area
LiDAR – Light detection and ranging
NDVI – Normalized difference vegetation index
NIR – Near infrared

Glossary

Building footprints – A vector dataset displaying horizontal extent of classified buildings within LiDAR point cloud.

Building footprint change detection – A vector showing the changes between 2018-2019 and 2022 building footprints using the following classes:

- ***Building footprint increase***: gains that are greater than 10 m^2
- ***Building footprint decrease***: losses that are greater than 10 m^2
- ***Unclassified***: change that is less than 10 m^2 (this category accounts for differences in accuracy between the two datasets and noise in the LiDAR dataset)
- ***No change***: areas that are the same as 2018-2019

Digital canopy model – A discontinuous raster that describes the horizontal extent and vertical height of tree canopy across an area of interest.

Digital terrain model – A continuous raster which shows the bare-earth elevation above sea level with buildings and trees removed.

Green space – Describes the maps of all actively growing vegetation such as trees, shrubs and grass regardless of height across an area of interest. Vegetation ≥2 m is identified through the LiDAR classified point cloud. Vegetation <2 m is identified through the NDVI classification.

Land ownership classes – Below is a list of all land ownership classes used in this analysis based on cadastral data current as of June 2022. Community land includes land parcels held for the benefit of the community, this includes land held by trusts and public institutions. Not specified includes land parcels missing ownership information in the cadastral data. State and local government roads were classified based on a roads (polygon) dataset supplied by DIT, which differentiates between roads maintained by local and state governments.

- Private
- Company
- Community
- Federal government
- Local government
- Local government (road)
- State government
- State government (road)
- Not specified

Land use classes – Below is a list of all land use classes used in this analysis. The list of classes is based on the 2021 generalised land use categories.

- Commercial
- Education

- Forestry
- Industrial / utilities
- Mining / quarrying
- Non private residential
- Primary production
- Public institution
- Recreation
- Reserve
- Residential
- Roads
- Vacant
- Not specified

Mid storey vegetation cover – Describes the horizontal extent of the tree canopy within between 2 to 3 m height showing the vertical structure and distribution of the canopy.

Percentage canopy cover – The percentage of canopy cover in each 100 m x 100 m grid cell.

Permeable and impermeable surfaces – Describes the classification of all surfaces across an area of interest, using the following classes:

- ***Impermeable ground***: such as pavement, concrete and roads
- ***Permeable ground***: such as base soil and grass
- ***Impermeable above ground***: such as buildings, tree canopy overhanging impermeable surfaces (e.g. roads) and other infrastructure
- ***Permeable above ground***: such as trees and vegetation that is not overhanging impermeable surfaces
- ***Water***: such as the ocean, lakes, rivers, dams and swimming pools
- ***Impermeable above ground class 6***: is an additional class used in the 2022 dataset to identify areas where tree canopy overlaps areas of impermeable surfaces such as car parks and pavements and are therefore identified as 'impermeable above ground'. These areas were not identified in the previous analysis as only road extents under tree canopy were classed as 'impermeable above ground'. Class 6 has been kept separate in the 2022 dataset to enable direct comparison with the previous dataset and to enable comparison with future datasets.

Tree canopy cover – A vector showing the precise horizontal extent of tree canopy cover ≥3 m in height. Allows for the percentage of tree canopy cover to be calculated across a range of areas of interest (e.g. LGA or unit area).

Tree canopy cover classification – Classification of the tree canopy cover for each type of land use category, land ownership category and DIT land types.

Tree canopy stratification – Describes the horizontal extent of the tree canopy within defined height intervals showing the vertical structure and distribution of the canopy.

Tree canopy cover change detection - A raster that represents the changes between 2018-2019 and 2022 tree canopy cover. Tree canopy cover change was classified using the following classes:

- ***Tree growth:*** gains that are connected to other canopy and have an area greater than 4 m^2
- ***Tree planting***: gains that are isolated from other tree canopy and have an area greater than 4 m^2

- ***Pruning reduction***: losses that are connected to other canopy and have an area greater than 4 m^2
- ***Tree removal***: losses that are isolated from other tree canopy and have an area greater than 4 m^2
- ***Unclassified***: change that is less than 4 m^2 (this category accounts for differences in accuracy between the two datasets)
- ***No change***: areas of canopy that are the same as 2018-2019. It is further classified into different categories using land use and land ownership boundaries.

Tree canopy cover by unit area change detection - A 100 m raster grid describes changes between 2018-2019 and 2022 tree canopy cover.

1. Survey summary

1.1. Survey area

The survey area for the project consisted of the entire Green Adelaide region plus the full extents of City of Onkaparinga and the Town of Gawler. The following LGAs fall within the survey area:

Council	Previous Capture	Previous Capture Year	Council	Previous Capture	Previous Capture Year
City of Adelaide	Complete	2018	City of Onkaparinga	Partial	2018-2019
City of Burnside	Complete	2018-2019	City of Playford	Partial	2018-2019
Campbelltown City Council	Complete	2018-2019	City of Port Adelaide Enfield	Complete	2018
City of Charles Sturt	Complete	2018	City of Prospect	Complete	2018
Town of Gawler	Partial	2018	City of Salisbury	Complete	2018-2019
City of Holdfast Bay	Complete	2018	City of Tea Tree Gully	Complete	2018-2019
City of Marion	Complete	2018	City of Unley	Complete	2018
City of Mitcham	Complete	2018-2019	Town of Walkerville	Complete	2018
City of Norwood Payneham & St. Peters	Complete	2018	City of West Torrens	Complete	2018

This report provides information specific to the Survey Area.

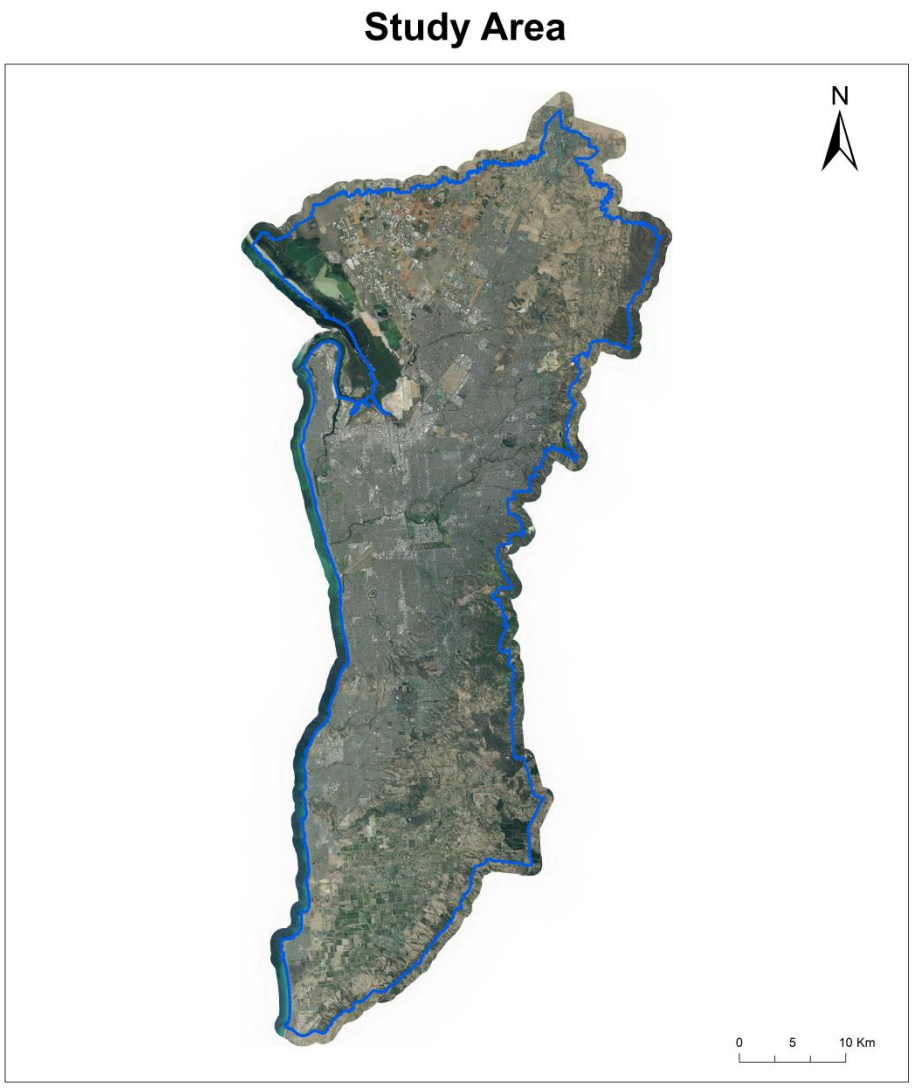

Figure 1: Extent of survey area

1.2. Survey methodology

In 2018 and 2019, LiDAR data and high resolution satellite multispectral imagery was captured over the majority of metropolitan Adelaide and subsequently analysed to investigate tree canopy cover (extent, height stratification, differences across different land use and ownership categories), and to derive a number of additional products including building footprints and permeable and impermeable surfaces.

In January and February 2022, LiDAR data and high resolution satellite multispectral imagery was captured over metropolitan Adelaide, to enable an updated analysis of tree canopy cover. Where possible, 2022 data capture specifications replicated the 2018-2019 captures to support change detection and quantifiable trend analysis across a range of aspects.

1.3. Processing methodology

Using Python, a custom application was developed for pixel value manipulation of each of the data analysis products.

Tree canopy cover by land use:
Tree canopy cover (≥3 m in height) and land use polygons were the inputs. Numerical codes (DNs) were assigned for each tree canopy cover pixel within land use polygons with respect to land use categories.

Tree canopy cover by land ownership:
Tree canopy cover (≥3 m in height) and land ownership polygons were the inputs. Numerical codes (DNs) were assigned for each tree canopy cover pixel within land ownership polygons with respect to land ownership category.

Tree canopy cover by DIT land types:
Tree canopy cover (≥3 m in height) and DIT land types polygons were the inputs. Numerical codes (DNs) were assigned for each tree canopy cover pixel within DIT land types polygons with respect to DIT land categories.

Tree canopy cover by unit area:
Tree canopy cover (≥3 m in height) was the input. A 100 m resolution raster grid (100 m x 100 m) was created representing the percentage of canopy cover within each 100 m unit area.

Stratified tree canopy height:
CHM was the input. Input height model was reclassified at 5 m intervals from 3 m to maximum height present in the datasets.

Mid-storey vegetation cover (2 to 3 m):
CHM was the input. Pixel values in the range between ≥2 m to <3 m in the input height model were extracted.

Green space:
Vegetation extents were extracted as polygons using AI/ML method and revised with respect to the imagery. The revised polygons were rasterized with the resolution of 0.5 m and appropriate projection (EPSG: 7854).

Permeable and impermeable surfaces:
Permeable and impermeable surface extents were partially extracted as polygons using AI/ML and some features were manually captured using the QGIS software. The output polygons were rasterized with the resolution of 0.5 m and appropriate projection (EPSG: 7854).

1.4. Change detection methodology

A custom built Python based application was used to carry out change detection by comparing each pixel between two rasters (2018-2019 and 2022) and the resultant raster was written as a GeoTiff output.

Tree canopy cover change detection:
2022 tree canopy cover (≥3 m in height) and 2018-2019 tree canopy cover were the inputs. Canopy cover raster from 2018-2019 and 2022 were compared pixel to pixel and changes in the values were extracted. The change has been classified into:

- ***Tree growth*** – gains that are connected to other canopy and have an area greater than 4 m^2
- ***Tree planting*** – gains that are isolated from another tree canopy and have an area greater than 4 m^2
- ***Pruning reduction*** – losses that are connected to other canopy and have an area greater than 4 m^2
- ***Tree removal*** – losses that are isolated from another tree canopy and have an area greater than 4 m^2
- ***Unclassified*** – change that is less than 4 m^2 (this category accounts for differences in accuracy between the two datasets)
- ***No change*** – areas of canopy that are the same as 2018-2019

Tree canopy height change detection:
2022 canopy height model (≥3 m in height) and 2018-2019 canopy height model were the inputs. CHM raster from 2018-2019 and 2022 were compared pixel to pixel and the results were extracted. The change has been classified into:

- Zero value indicates no change in tree canopy height,
- Negative value indicates a reduction in tree canopy height and
- Positive value indicates an increase in tree canopy height.

Tree canopy cover by unit area change detection:
2022 canopy cover by unit area raster (100m x 100m) and 2018-2019 canopy cover by unit area raster (100m x 100m) were the inputs. Each pixel from the 2022 raster was compared with the corresponding pixel in the 2018-2019 raster and the difference value was added as DN (pixel value) in the output change detection raster (100m x 100m). The change has been classified into:

- Zero value indicates no change in percentage of tree canopy cover,
- Negative value indicates a reduction in percentage of tree canopy cover, and
- Positive value indicates an increase in percentage of tree canopy cover

Building footprint change detection:
2022 building footprints and 2018-2019 building footprints were the inputs. Building footprints from 2018-2019 and 2022 were rasterized and compared pixel to pixel and the results extracted. The change was classified into:

- ***Building footprint increase*** – gains greater than 10 m^2
- ***Building footprint decrease*** – losses greater than 10 m^2
- ***Unclassified*** – change less than 10 m^2 (this category accounts for differences in accuracy between the two datasets and noise in the LiDAR dataset)
- ***No change*** – areas that are the same as 2018-2019

1.5. Accuracy assessment methodology

Accuracy assessments were undertaken on both the green space, and permeable and impermeable surface datasets. Accuracy assessments were undertaken across the entire dataset to provide an overall accuracy for each dataset. The assessments were made on the permeable and impermeable surface extents and green space with reference to the satellite imagery using the hundred points which are generated randomly. Each point was visually assessed and the calculation of accuracy assessments were made using the below formula:

po=Overall accuracy
pe= Matrix of two arrays(sum of producer and user values)

$$k = (po - pe) / (1 - pe)$$

2. Summary of deliverables

Outlined below is a summary of each deliverable presented within this report. Each of the deliverables was generated at the following scales:

- Entire survey area
- Green Adelaide region
- Each LGA within the survey area
- DIT owned and managed land

2.1. Summary of spatial datasets derived from the 2022 data capture

Table 1: Summary of datasets derived from 2022 data capture

Section	2022 derived spatial datasets
3.1	Tree canopy cover (≥3 m in height)
3.2	Tree canopy cover by land use
3.3	Tree canopy cover by land ownership
3.4	Stratified tree canopy height
3.5	Tree canopy cover by unit area
4.1	Green space
5.1	Permeable and impermeable surfaces
5.2	Building footprints

2.2. Summary of change detection analysis

Outlined in the table below is the range of spatial datasets generated through comparison of 2022 data with 2018-2019 data.

Table 2: Summary of change detection datasets

Section	Change detection analysis (comparing 2022 data with 2018-2019 data)
6.1	Tree canopy cover change detection
6.2	Tree canopy cover by unit area change detection
6.3	Building footprint change detection

3. Tree canopy cover

3.1. Tree canopy cover horizontal extents

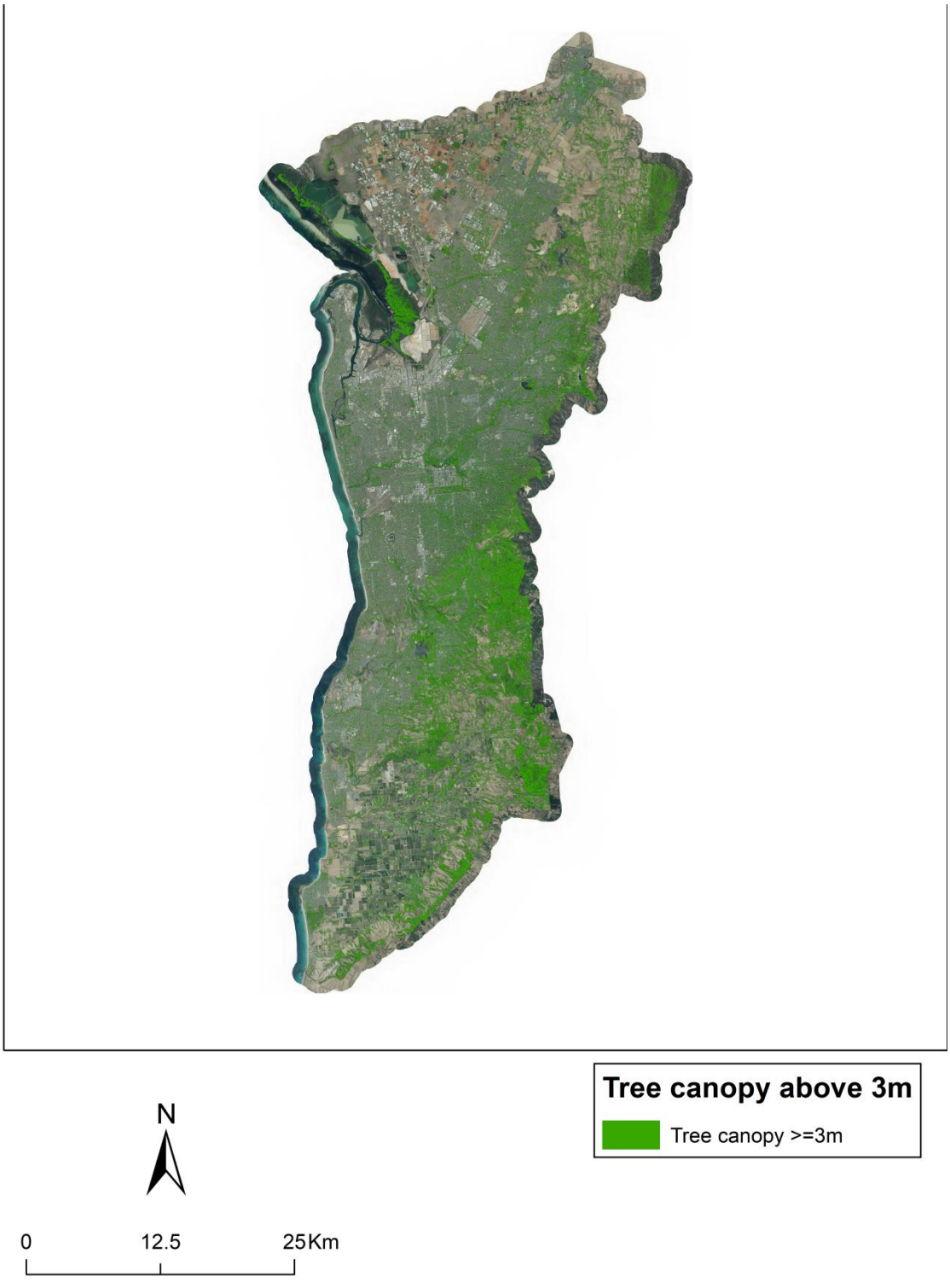

Figure 2: Tree canopy cover (≥3 m in height) horizontal extents

In the below pie chart, green indicates the percentage of tree canopy cover (≥3 m in height) and grey indicates the percentage of non-canopy area within the Survey Area.

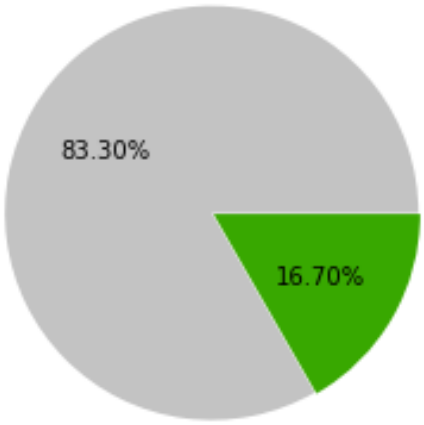

Figure 3: Percentage of tree canopy cover (≥3 m in height)

Table 3: Total area and % of total area covered by tree canopy (≥3 m in height)

Total area (m^2)	Tree canopy area (m^2)	% of tree canopy	% of non-canopy
1,623,445,706	271,083,502	16.70%	83.30%

Description:
The horizontal extent of tree canopy cover (≥3 m in height) across the Survey Area. This data was derived from the CHM and depicts the exact area that is covered by tree canopy. Total tree canopy cover (≥3 m in height) has been calculated at 16.70% within the Survey Area (Figure 2).

3.2. Tree canopy cover by land use

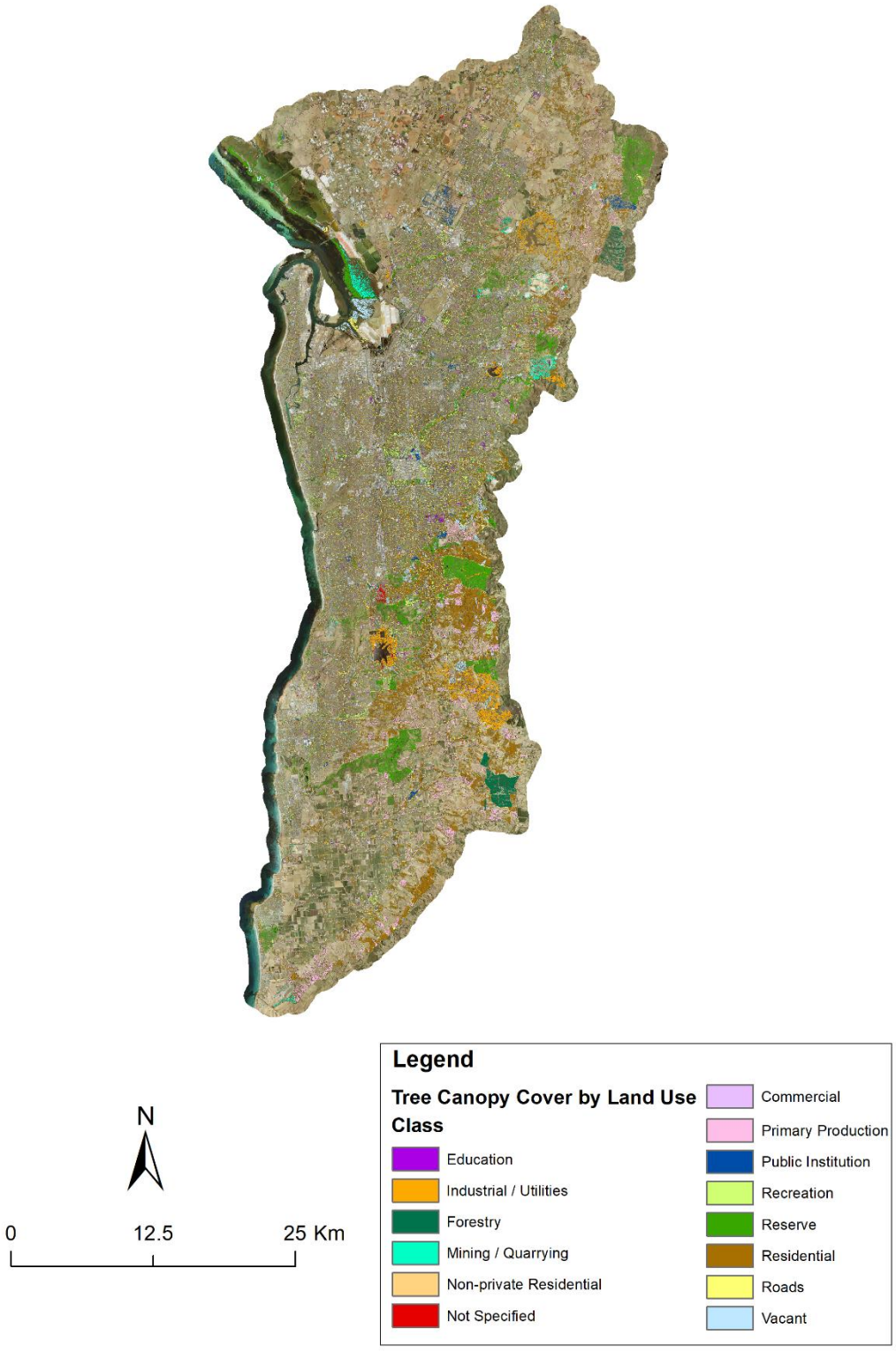

Figure 4: Tree canopy cover (≥3 m in height) classified by land use

Table 4: Total area (m^2) and percentage cover of tree canopy (≥3 m in height) by land use type

Class	Land use type	Total area (m^2)	Canopy area (m^2)	% of land use type covered by canopy
1	Commercial	45,968,268	2,351,865	5.12%
2	Education	19,148,304	3,090,839	16.14%
3	Industrial / utilities	98,383,659	17,270,541	17.55%
4	Forestry	12,995,507	6,591,617	50.72%
5	Mining / quarrying	55,684,234	4,732,847	8.50%
6	Non-private residential	7,469,421	798,242	10.69%
7	Not specified	7,980,424	1,292,757	16.20%
8	Primary production	348,787,991	32,229,758	9.24%
9	Public institution	29,308,789	3,917,177	13.37%
10	Recreation	40,597,095	8,317,214	20.49%
11	Reserve	142,330,454	43,222,559	30.37%
12	Residential	557,627,238	98,406,388	17.65%
13	Roads	184,561,582	36,258,463	19.65%
14	Vacant	68,302,253	12,603,235	18.45%

NB: The total land use area is less than the total study area due to the different alignment of the study area boundary and the land use mapping along the coastline.

Description:

The total area of tree canopy cover (≥ 3 m in height) divided into areas that correspond to different land use types (Figure 4), and the area and percentage of tree canopy cover that covers each land use type (Table 4). For example, tree canopy cover is 17.65% over all land with land use classified as residential within the Survey Area.

3.3. Tree canopy cover by land ownership

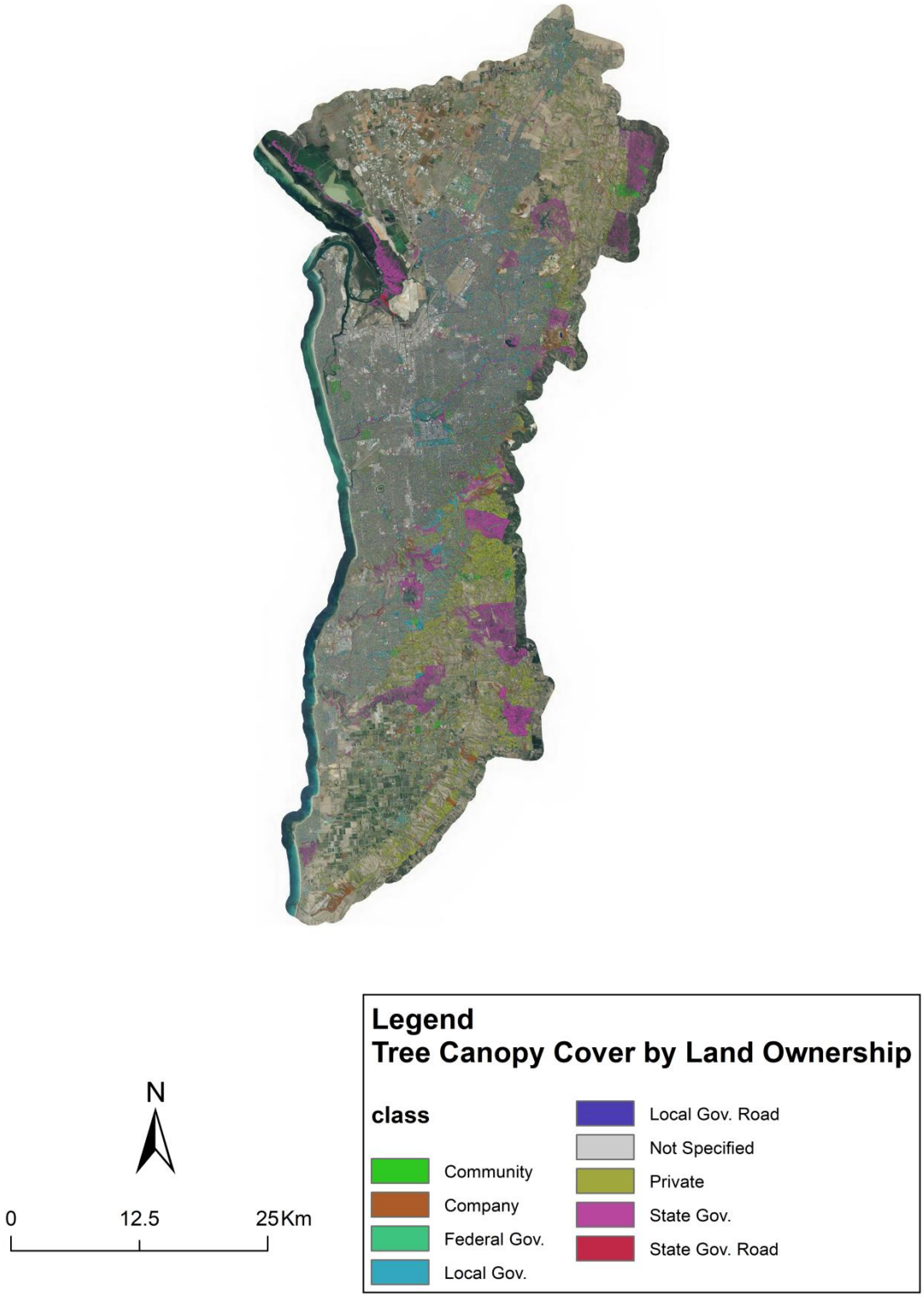

Figure 5: Tree canopy cover (≥3 m in height) classified by land ownership

Table 5: Total area (m^2) and percentage cover of tree canopy (≥3 m in height) by land ownership type

Class	Land ownership type	Total area (m^2)	Canopy area (m^2)	% of land ownership type covered by canopy
1	Community	37,285,183	6,032,427	16.18%
2	Company	277,957,000	20,791,245	7.48%
3	Federal government	31,413,950	1,611,639	5.13%
4	Local government	87,023,064	24,593,485	28.26%
5	Local government (road)	141,842,648	28,383,682	20.01%
6	Not specified	6,572,596	1,381,254	21.02%
7	Private	706,750,597	115,922,508	16.40%
8	State government	287,544,468	66,286,119	23.05%
9	State government (road)	42,848,036	6,080,809	14.19%

NB: The total land use area is less than the total study area due to the different alignment of the study area boundary and the land use mapping along the coastline.

Description:

The total area of tree canopy cover (≥3 m in height) divided into areas that correspond to different land ownership types (Figure 5), and the area and percentage of tree canopy cover that covers each land ownership type (Table 5). For example, tree canopy cover is 28.26% over all land with land ownership classified as local government within the Survey Area.

3.4. Tree canopy height stratification

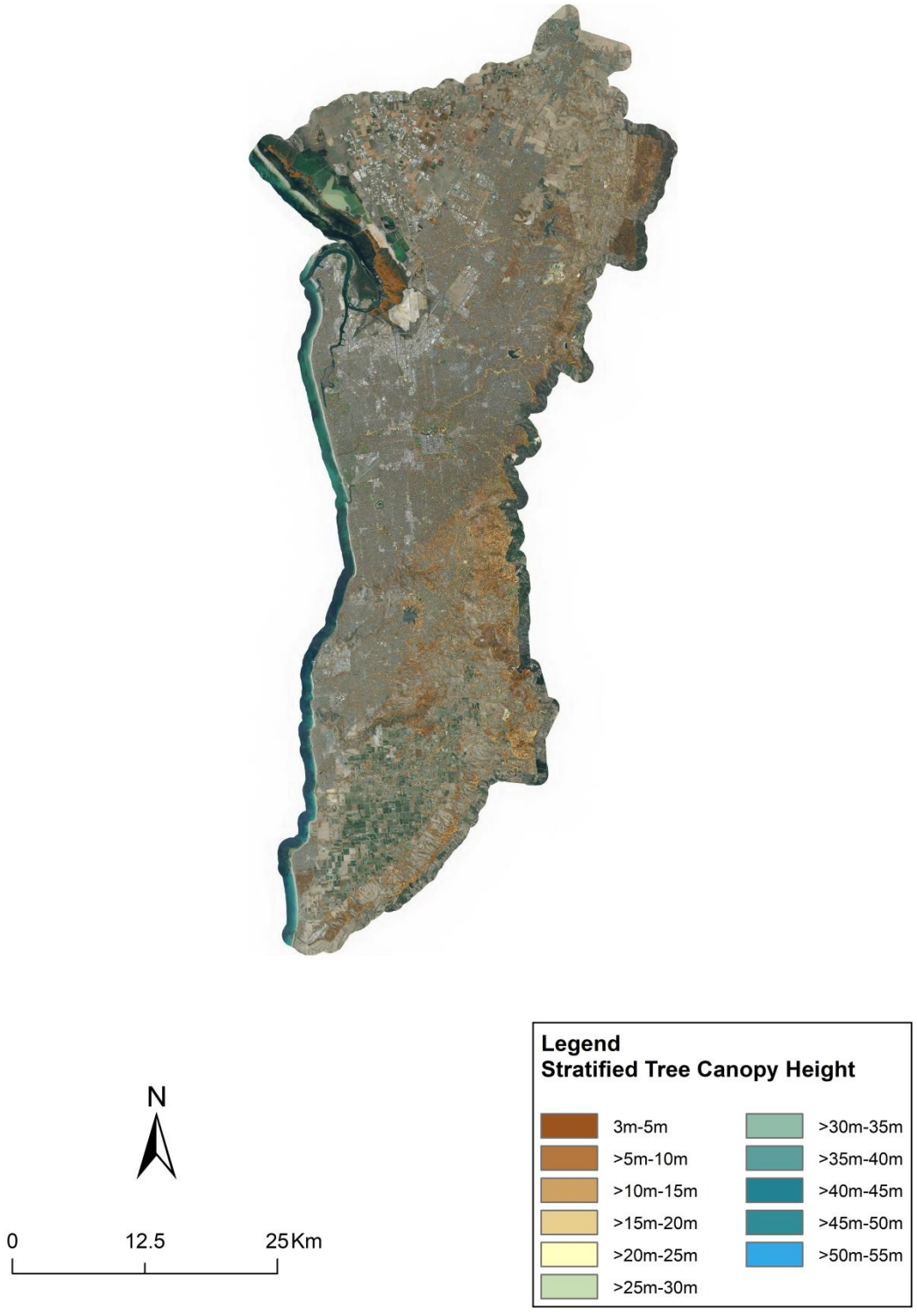

Figure 6: Tree canopy height stratification

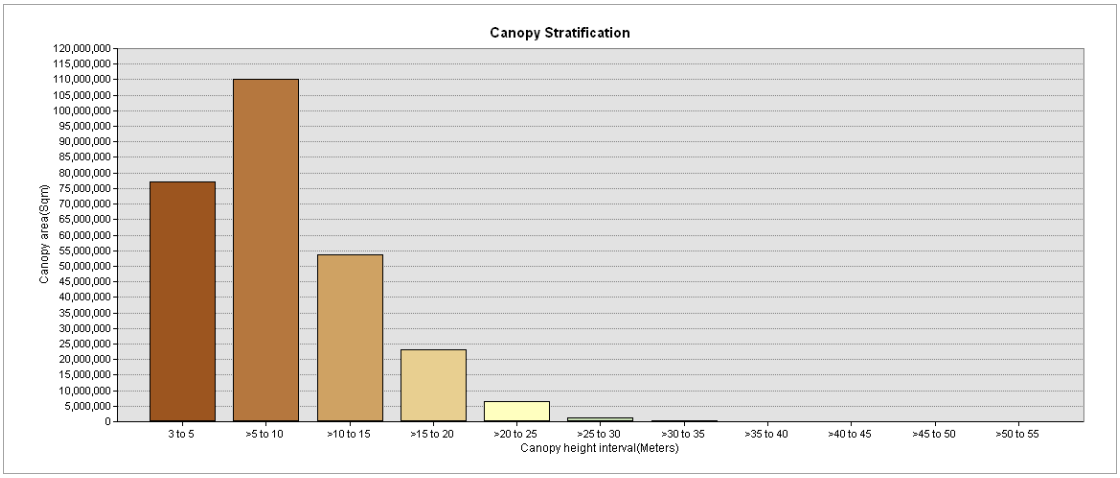

Figure 7: Tree canopy height stratification displayed by 5 m intervals

Table 6: Total area (m^2) and % of total tree canopy cover for each canopy stratification level

Class	Stratification interval	Area (m^2)	Percent of total canopy cover
1	3 to 5 m	77,133,948	28.45%
2	>5 to 10 m	110,177,369	40.63%
3	>10 to 15 m	53,573,826	19.76%
4	>15 to 20 m	22,456,801	8.28%
5	>20 to 25 m	6,401,733	2.36%
6	>25 to 30 m	1,214,308	0.45%
7	>30 to 35 m	172,902	0.06%
8	>35 to 40 m	32,910	0.01%
9	>40 to 45 m	4,769	0.00%
10	>45 to 50 m	135	0.00%
11	>50 to 55 m	2	0.00%

Description:

The area that is covered by tree canopy within defined height above ground intervals, ranging from 3 m up to the maximum canopy height (Figure 6). All tree canopy areas are classified at 5 m interval ranging from 3 to 5 m, >5 to 10 m, >10 to 15 m, >15 to 20 m, etc. to maximum tree canopy height in that tile. From this classification, the percentage of the total tree canopy cover in each height range within the Survey Area is listed (Figure 7). For example, total tree canopy is dominated by canopy within the height range of 5 to 10 m within the Survey Area.

3.5. Tree canopy cover by unit area

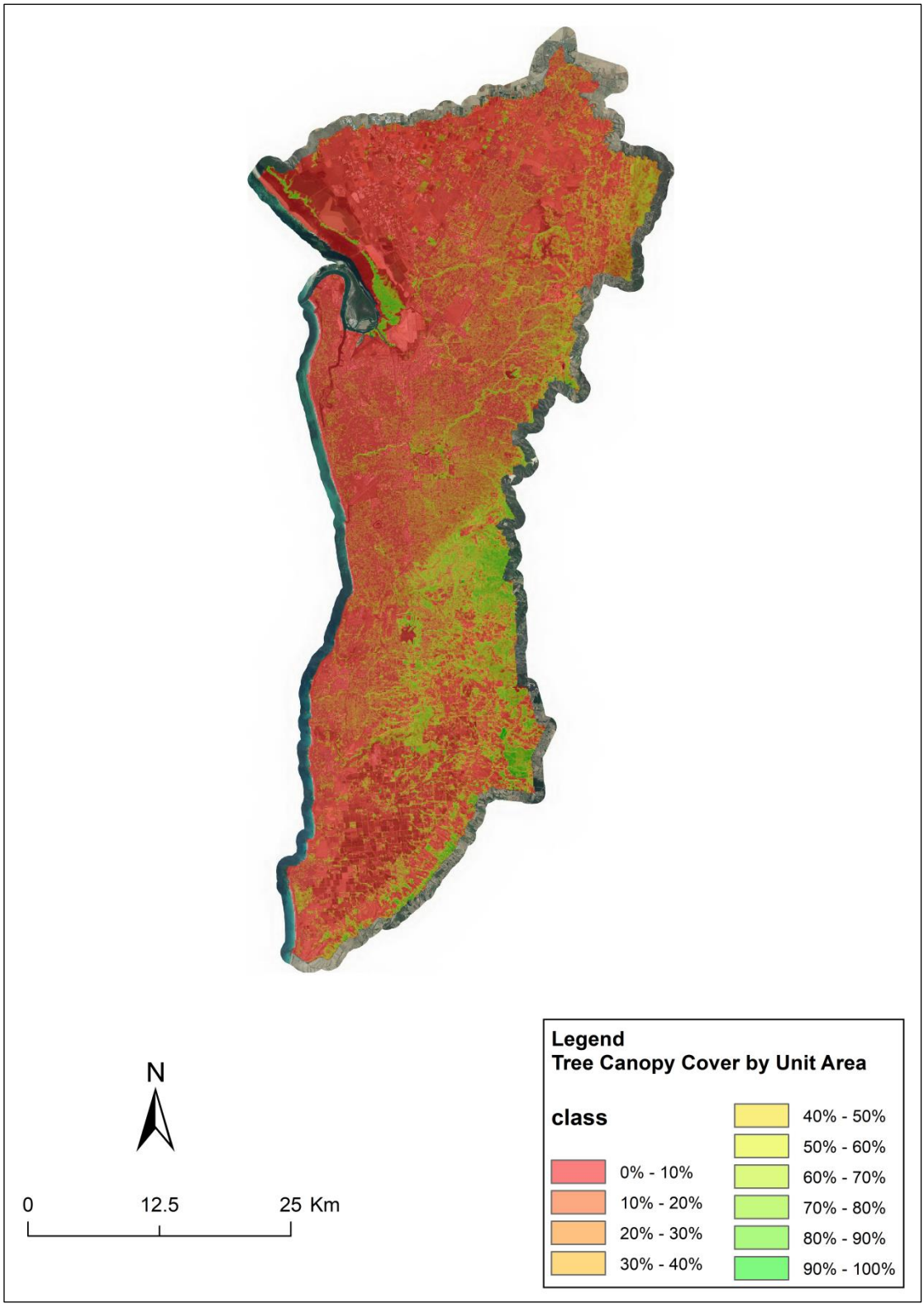

Figure 8: Tree canopy cover displayed by percentage canopy cover in 100 m x 100 m units

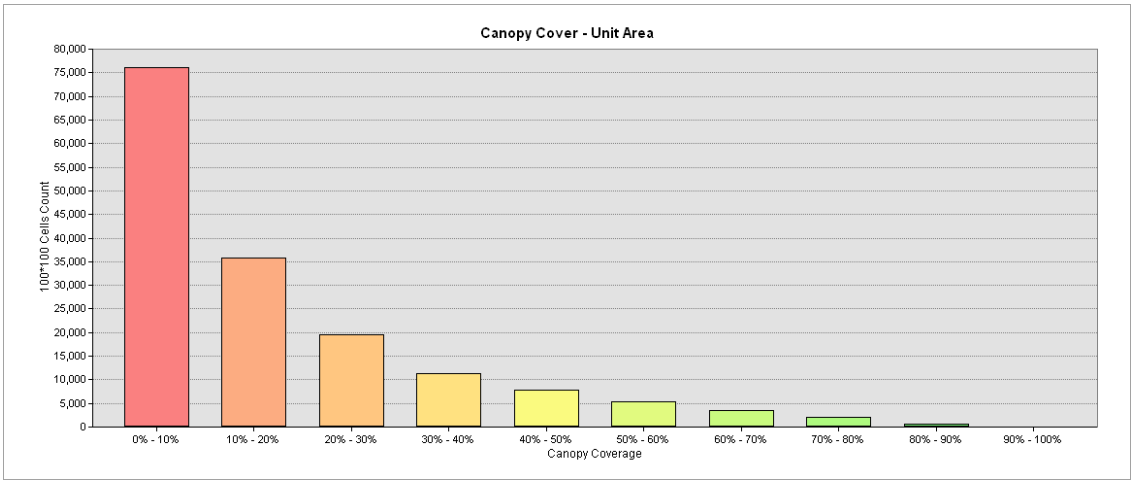

Figure 9: Bar graph of total number of 100 m x 100 m units within each canopy cover % interval

Table 7: Number of 100 m x 100 m cells at each percentage canopy cover interval

Percentage canopy coverage	Number of 100 m x 100 m cells	Percent of total canopy cover
0% - 10%	76,029	46.8%
10% - 20%	35,797	22.0%
20% - 30%	19,604	12.1%
30% - 40%	11,388	7.0%
40% - 50%	7,835	4.8%
50% - 60%	5,419	3.3%
60% - 70%	3,539	2.2%
70% - 80%	2,025	1.2%
80% - 90%	674	0.4%
90% - 100%	65	0.0%

Description:

Tree canopy cover by unit area generated by dividing the area of interest into uniform 100 m by 100 m cells and then calculating the percentage of tree canopy cover within each individual cell. All cells are then colour coded by percentage canopy cover (Figure 8). From this classification, we have calculated the tree canopy coverage (≥ 3 m in height) percentage in each 100 m grid cell within the Survey Area (Figure 9). For example, areas with 0% - 10% tree canopy cover 76,029 (100 m x 100 m) cells within the Survey Area.

4. Green space

4.1. Green space extents

Figure 10: Green space horizontal extents

In the below pie chart, green indicates the percentage of green space and grey indicates the percentage of non-green space within the Survey Area.

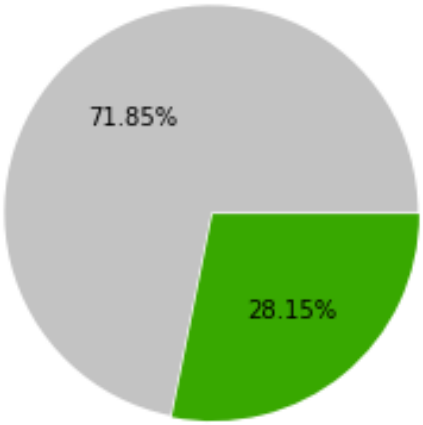

Figure 11: Percentage of green space

Table 8: Total area (m^2) and % of total area covered by green space

Class	Total area (m^2)	Green space area (m^2)	% of green space	% of non-green space
1	1,623,445,706	456,982,821	28.15%	71.85%

Accuracy assessment error matrix:

	Green space	Non-green space	Sum
Green space	47	0	47
Non-green space	4	49	53
Sum	51	49	100

Producer's accuracy	92%	100%
User's accuracy	100%	92%

Overall accuracy	96%
Overall Kappa index of agreement	0.92

Description:
Green space extent shows the area that is covered by all actively growing vegetation such as trees, shrubs and grass within the study area. Green space maps are generated using NIR imagery (Figure 10). From this classification, the percentage of the green space within the study area has been calculated (Table 8).

The green space dataset has an overall accuracy of 96% and an overall Kappa index of agreement of 0.92 (almost perfect).

5. Built environment

5.1. Permeable and impermeable surfaces

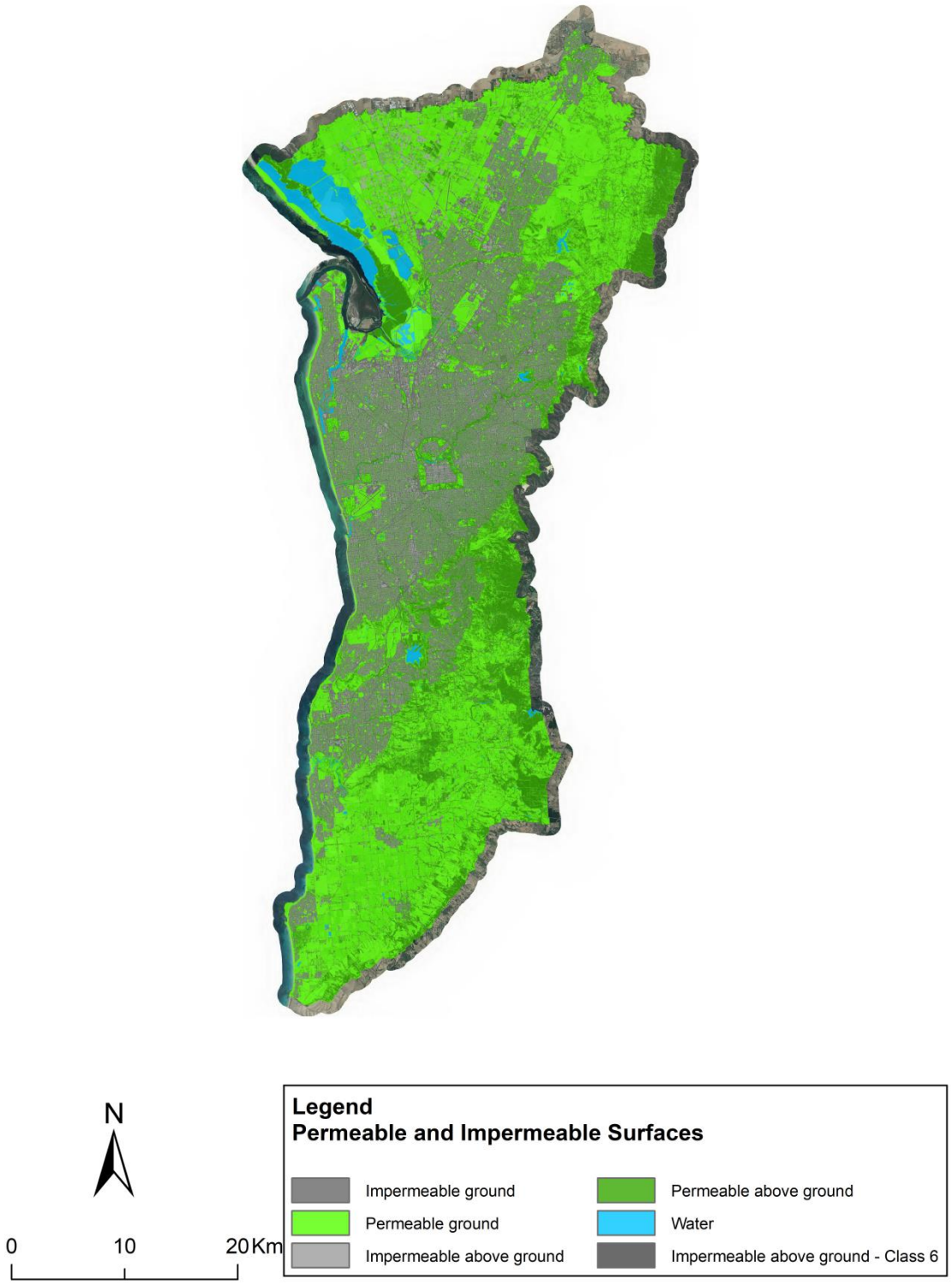

Figure 12: Extents of permeable and impermeable surfaces

In the below pie chart, light green indicates the percentage of permeable (ground), dark green indicates permeable (above ground), mid-grey indicates impermeable (ground), light grey indicates impermeable (above ground), dark grey indicates impermeable (above ground - class 6) and blue indicates water.

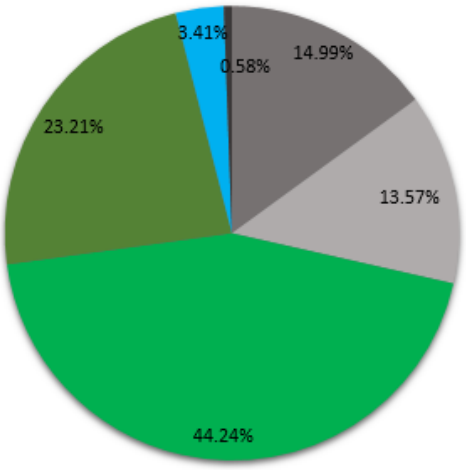

Figure 13: Percentage of permeable and impermeable surfaces

Table 9: Total area (m²) and % of permeable and impermeable surface types

Class	Surface	Total area (m²)	% surface
1	Impermeable (ground)	243,385,865	14.99%
2	Permeable (ground)	718,132,704	44.24%
3	Impermeable (above ground)	220,358,817	13.57%
4	Permeable (above ground)	376,729,539	23.21%
5	Water	55,299,617	3.41%
6	Impermeable (above ground - class 6)	9,443,689	0.58%

Accuracy assessment error matrix:

	Permeable	Impermeable	Water	Sum
Permeable	43	0	0	43
Impermeable	1	52	0	53
Water	0	0	4	4
Sum	44	52	4	100

Producer's accuracy	98%	100%	100%
User's accuracy	100%	98%	100%

Overall accuracy	99%
Overall Kappa index of agreement	0.98

Description:
Permeable and impermeable surface shows the area that is covered by impermeable surfaces (such as roads, carparks, footpaths, and buildings) and permeable surfaces (such as grass, shrubs, and trees) within the Survey Area. The data is classified as impermeable (ground), permeable (ground), impermeable (above ground), permeable (above ground), water and impermeable (above ground - class 6). Impermeable surface maps are generated using NIR imagery (Figure 12). From this classification, the percentage of permeable and impermeable surfaces within the Survey Area has been calculated (Table 9). The total

percentage of permeable surfaces is 67.45% and the total percentage of impermeable surfaces is 29.14%. Water covers 3.41% of the surface within the Survey Area.

The permeable and impermeable surface dataset has an overall accuracy of 99% and an overall Kappa index of agreement of 0.98 (almost perfect).

5.2. Building footprints

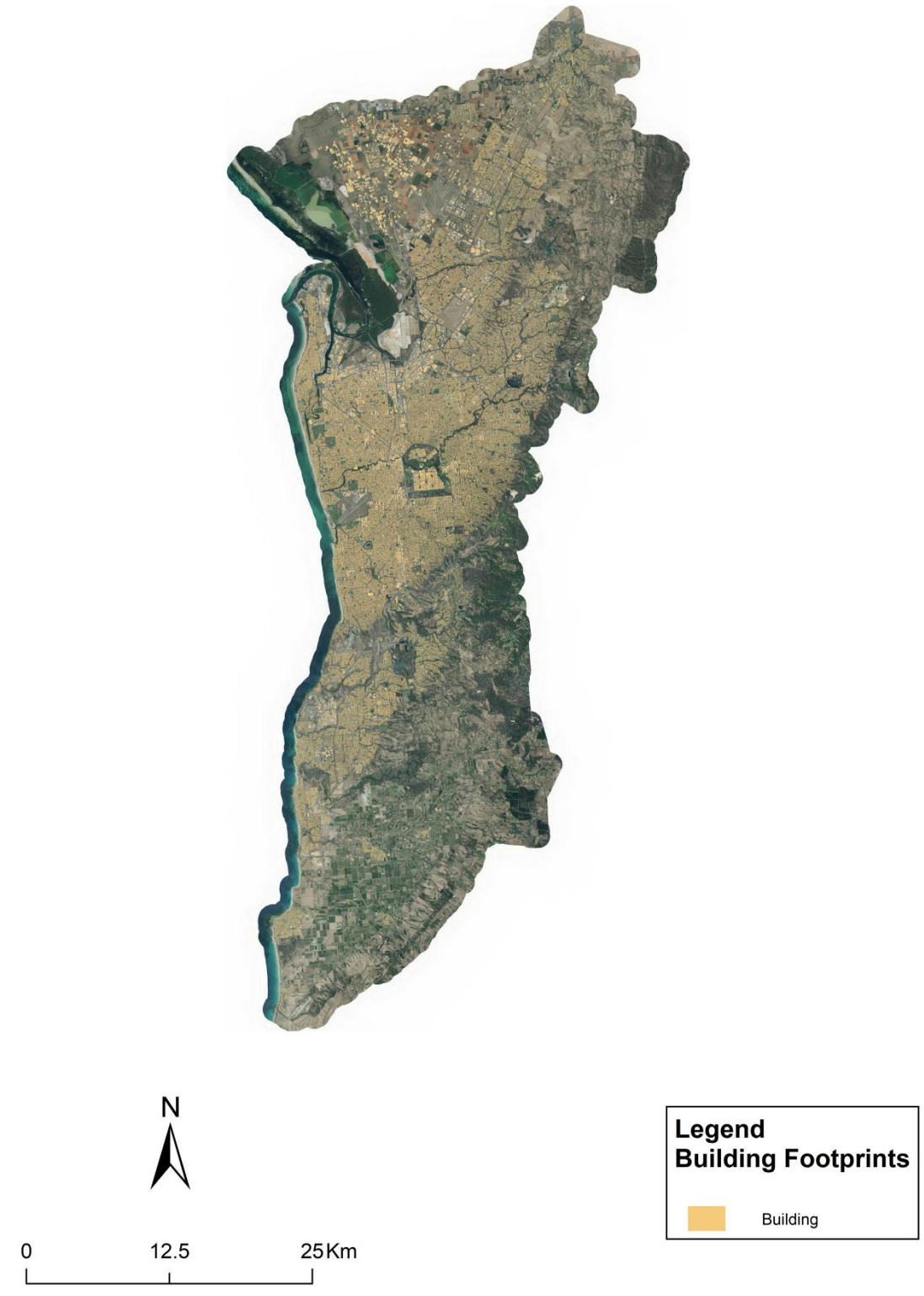

Figure 14: Extent of building footprints

In the below pie chart, light ochre indicates percentage of building footprints and grey indicates percentage of non-building area within the Survey Area.

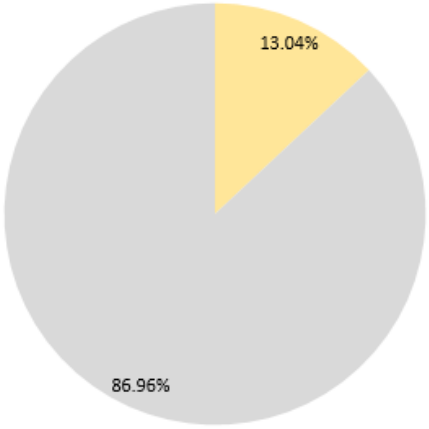

Figure 15: Percentage of area covered by building footprints

Table 10: Total area (m²) and percentage of area covered by building footprints

Class	Total area (m²)	Building area (m²)	% of building	% of non-building area
1	1,623,445,706	211,708,056	13.04%	86.96%

Description:
Building footprints for the Survey Area. Building outlines are generated using the error fixed LiDAR dataset (Figure 14). From this classification, the percentage of building footprints within the study area has been calculated (Table 10).

6. Change detection analysis

6.1. Tree canopy cover change detection

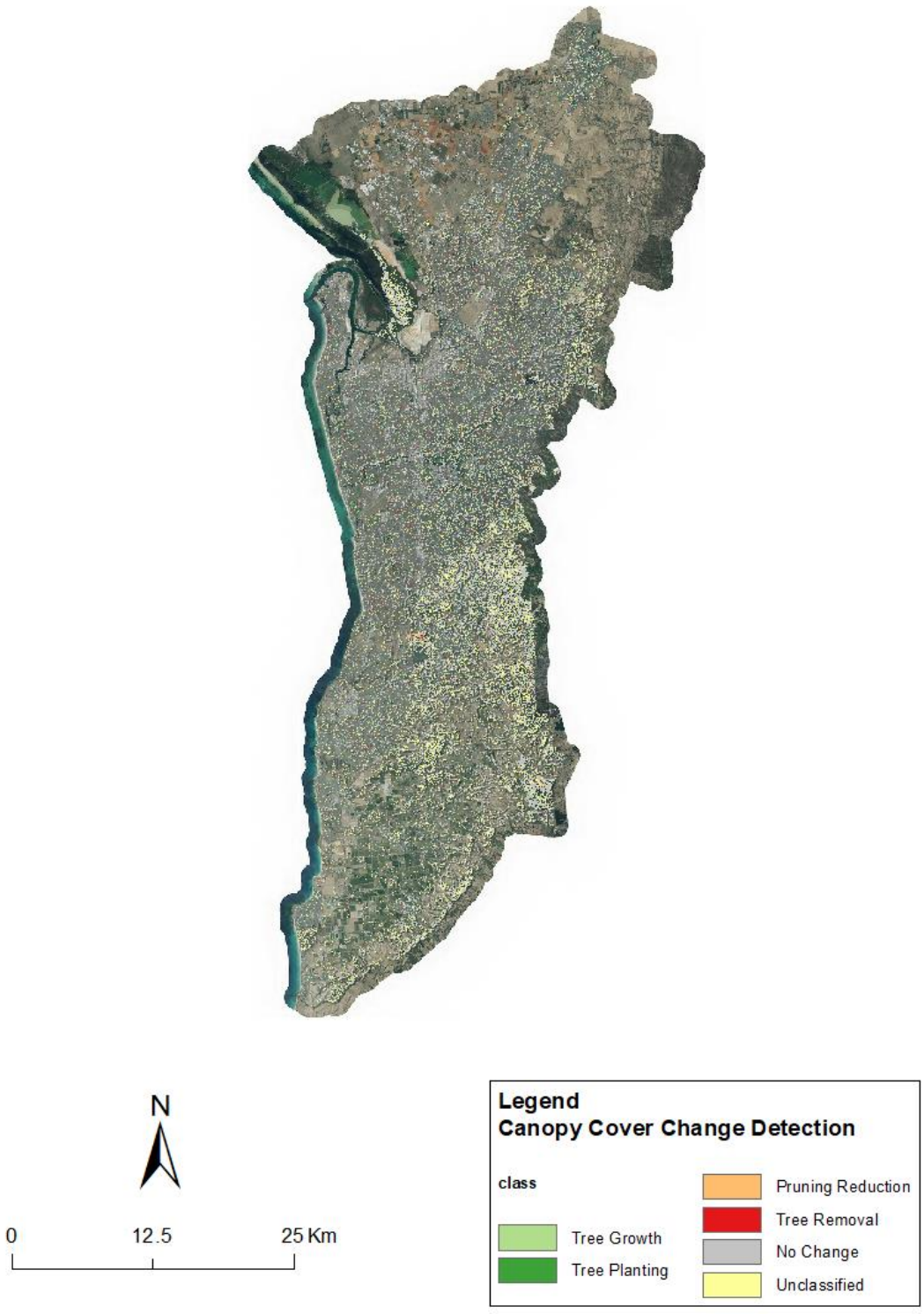

Figure 16: Tree canopy cover horizontal extents change detection

Table 11: Total area (m²) and percentage horizontal canopy cover change

Class	Changes	Canopy changes area in m²	% change
1	Tree growth	28,135,841	10.51%
2	Tree planting	1,268,988	0.47%
3	Pruning reduction	7,922,916	2.96%
4	Tree removal	2,959,211	1.11%
5	No change	161,739,067	60.43%
6	Unclassified	65,633,392	24.52%

NB: The study area was only partially captured in 2018-2019, therefore change was only calculated for areas captured in 2018-2019.

Table 12: Total area (m²) and percentage of total tree canopy loss or gain measured in each land use type

Class	Land use type	Total area (m²)	Tree growth (m²)	Tree growth (%)	Tree planting (m²)	Tree planting (%)	Pruning reduction (m²)	Pruning reduction (%)	Tree removal (m²)	Tree removal (%)	Unclassified (m²)	Unclassified (%)	No change (m²)	No change (%)
1	Commercial	44,915,694	432,054	0.96%	42,049	0.09%	150,993	0.34%	151792	0.34%	491,920	1.10%	1,565,821	3.49%
2	Education	18,770,319	453,958	2.42%	20,579	0.11%	156,962	0.84%	74,198	0.40%	622,101	3.31%	2,168,022	11.55%
3	Industrial / utilities	89,891,862	1,176,310	1.31%	58,441	0.07%	335,923	0.37%	83,885	0.09%	2663,102	2.96%	7,580,306	8.43%
4	Forestry	6,972,053	1,042,206	14.95%	16,506	0.24%	380,359	5.46%	75,108	1.08%	3,420,454	49.06%	6,217,939	89.18%
5	Mining / quarrying	32,075,390	438,219	1.37%	14,347	0.04%	27,547	0.09%	8,377	0.03%	1,659,944	5.18%	2,667,582	8.32%
6	Non-private residential	7,405,020	153,641	2.07%	13,221	0.18%	47,421	0.64%	24,225	0.33%	169,989	2.30%	525,512	7.10%
7	Not specified	6,338,189	136,974	2.16%	5,441	0.09%	46,596	0.74%	14,095	0.22%	304,565	4.81%	838,857	13.23%
8	Primary production	224,717,737	2,430,987	1.08%	69,634	0.03%	245,415	0.11%	71,341	0.03%	7,542,690	3.36%	17,024,256	7.58%
9	Public institution	25,224,869	379,629	1.50%	19,807	0.08%	98,111	0.39%	47,147	0.19%	695,528	2.76%	2,215,393	8.78%
10	Recreation	38,195,557	858,639	2.25%	25,012	0.07%	218,123	0.57%	56,723	0.15%	1,805,575	4.73%	5,871,521	15.37%
11	Reserve	106,037,506	3,867,933	3.65%	91,408	0.09%	550,448	0.52%	54,560	0.05%	11,399,408	10.75%	24,618,280	23.22%
12	Residential	473,798,498	10,757,042	2.27%	595,651	0.13%	4,363,686	0.92%	1,599,908	0.34%	23,439,104	4.95%	60,006,474	12.66%
13	Roads	169,921,262	4,783,992	2.82%	248,705	0.15%	937,164	0.55%	442,570	0.26%	7,940,903	4.67%	22,182,049	13.05%
14	Vacant	62,193,919	1,221,254	1.96%	48,130	0.08%	357,843	0.58%	249,930	0.40%	3,465,444	5.57%	8,179,735	13.15%

NB: The study area was only partially captured in 2018-2019, therefore change was only calculated for areas captured in 2018-2019. The total land use area is less than the total study area due to the different alignment of the study area boundary and the land use mapping along the coastline. The total of the change categories are also less than those reported in Table 11 due to some canopy (e.g. mangrove vegetation) falling outside of the land use mapping.

Table 13: Total area (m²) and percentage of total tree canopy loss or gain measured in each land ownership type

Class	Land ownership type	Total area (m²)	Tree growth (m²)	Tree growth (%)	Tree planting (m²)	Tree planting (%)	Pruning reduction (m²)	Pruning reduction (%)	Tree removal (m²)	Tree removal (%)	Unclassified (m²)	Unclassified (%)	No change (m²)	No change (%)
1	Community	32,832,340	671,709	2.05%	38,480	0.12%	222,980	0.68%	103,061	0.31%	1,164,026	3.55%	3,515,036	10.71%
2	Company	201,530,151	2,293,921	1.14%	117,050	0.06%	500,733	0.25%	380,807	0.19%	5,170,069	2.57%	11,767,416	5.84%
3	Federal government	28,890,800	199,295	0.69%	12,045	0.04%	43,380	0.15%	30,810	0.11%	346,408	1.20%	1,101,104	3.81%
4	Local government	84,282,320	3,096,429	3.67%	96,880	0.11%	535,823	0.64%	94,331	0.11%	5,850,757	6.94%	17,086,941	20.27%
5	Local government (road)	132,100,804	4,045,624	3.06%	207,995	0.16%	799,815	0.61%	381,865	0.29%	6,544,874	4.95%	18,534,635	14.03%
6	Not specified	6,511,166	176,601	2.71%	6,959	0.11%	60,254	0.93%	20,430	0.31%	315,289	4.84%	972,655	14.94%
7	Private	560,548,042	11,430,413	2.04%	600,270	0.11%	4,350,763	0.78%	1,598,223	0.29%	26,954,222	4.81%	67,869,779	12.11%
8	State government	221,909,190	5,478,582	2.47%	148,401	0.07%	1,265,046	0.57%	283,303	0.13%	17,877,444	8.06%	37,163,458	16.75%
9	State government (road)	37,869,428	741,128	1.96%	40,922	0.11%	137,955	0.36%	61,198	0.16%	1,398,522	3.69%	3,653,310	9.65%

NB: The study area was only partially captured in 2018-2019, therefore change was only calculated for areas captured in 2018-2019. The total land use area is less than the total study area due to the different alignment of the study area boundary and the land use mapping along the coastline. The total of the change categories are also less than those reported in Table 11 due to some canopy (e.g. mangrove vegetation) falling outside of the land use mapping.

Table 14: Summary of total and % change on public land and private land use types

Class	Land ownership type	Total area (m²)	Tree growth (m²)	Tree growth (%)	Tree planting (m²)	Tree planting (%)	Pruning reduction (m²)	Pruning reduction (%)	Tree removal (m²)	Tree removal (%)	Unclassified (m²)	Unclassified (%)	No change (m²)	No change (%)
1	Total public land	505,052,542	13,561,058	2.69%	50,6243	0.10%	2,782,018	0.55%	851,507	0.17%	32,018,005	6.34%	77,539,447	15.35%
2	Total private land	794,910,533	14,396,043	1.81%	755,800	0.10%	5,074,476	0.64%	2,082,090	0.26%	33,288,317	4.19%	83,152,231	10.46%
3	Other	6,511,166	176,601	2.71%	6,959	0.11%	60,254	0.93%	20,430	0.31%	315,289	4.84%	972,655	14.94%

NB: The study area was only partially captured in 2018-2019, therefore change was only calculated for areas captured in 2018-2019. The total land use area is less than the total study area due to the different alignment of the study area boundary and the land use mapping along the coastline. The total of the change categories are also less than those reported in Table 11 due to some canopy (e.g. mangrove vegetation) falling outside of the land use mapping.

Description:

Tree canopy cover change detection for the Survey Area shows the changes in canopy cover between the 2018-2019 dataset and the 2022 dataset. Change detection was undertaken to detect changes such as tree growth, tree planting, tree pruning, tree removal and unclassified (Figure 16). Overall changes with respect to the 2018-2019 dataset are listed (Table 11), as well as further classified using the land use (Table 12) and land ownership (Table 13) categories, and summary in Table 14.

6.2. Tree canopy cover by unit area change detection

Figure 17: Percentage tree canopy change cover by 100 m x 100 m unit area. Note that a 0.5% tolerance is applied to the 'no change' class.

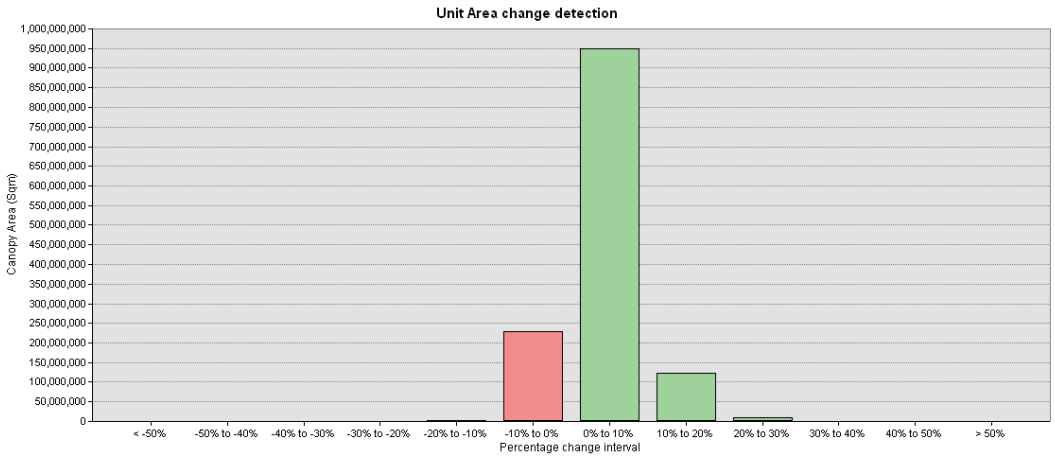

Figure 18: Graph of interval % increase and decrease

Table 15: Total area in each of the percentage change categories and % total area changed

% change class	Total area (m^2)	Percent of total change
< -50%	350,000	0.03%
-50% to -40%	50,000	0.00%
-40% to -30%	170,000	0.01%
-30% to -20%	460,000	0.04%
-20% to -10%	2,660,000	0.20%
-10% to 0%	228,320,000	17.40%
0% to 10%	948,240,000	72.25%
10% to 20%	121,910,000	9.29%
20% to 30%	9,050,000	0.69%
30% to 40%	970,000	0.07%
40% to 50%	200,000	0.02%
> 50%	70,000	0.01%

NB: The study area was only partially captured in 2018-2019, therefore change was only calculated for areas captured in 2018-2019

Description:

Tree canopy cover by unit area change detection for the Survey Area shows the changes in the unit area of canopy cover between the 2018-2019 dataset and the 2022 dataset. Change detection was undertaken to detect changes between 100 m grid cells (Figure 17) and assess the percentage of total change in each change class (Table 15).

6.3. Building footprint change detection

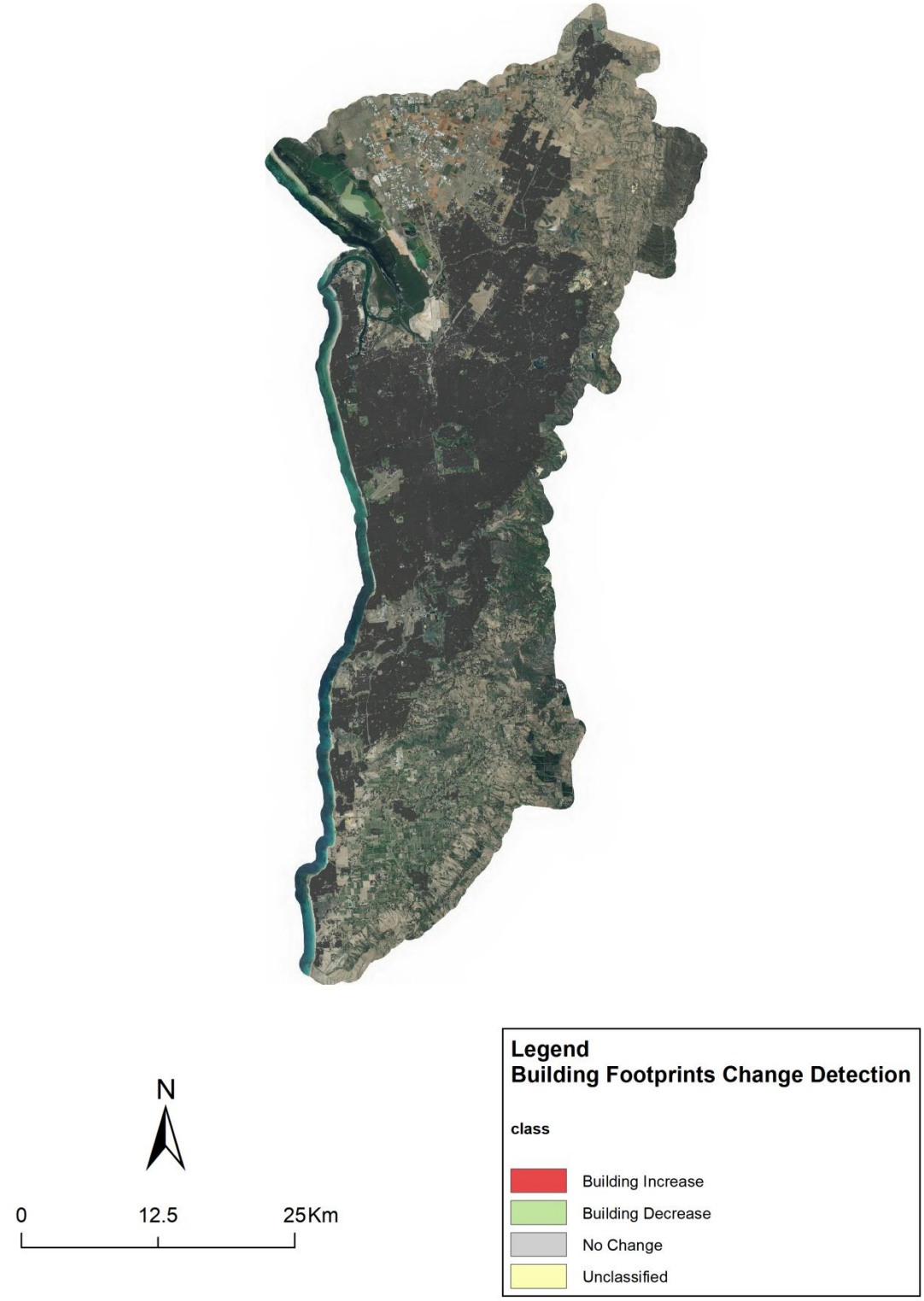

Figure 19: Building footprint change detection

Table 16: Total area building footprint change (m^2) and percentage change

Class	Changes	Building changes area in m^2	% of changes
1	Increase	16,384,629	9.20%
2	No change	172,765,962	96.99%
3	Decrease	3,409,968	1.91%
4	Unclassified	12,383,521	6.95%

NB: The study area was only partially captured in 2018-2019, therefore change was only calculated for areas captured in 2018-2019. Change percentage are taken against 2018 building dataset.

Description:

Building footprint change detection for the Survey Area shows the changes which are greater than 10 m^2 (squared off to whole number) between the 2018-2019 dataset and the 2022 dataset. Change detection was undertaken to detect changes such as building footprint increase, building footprint decrease and unclassified (Figure 19). Overall changes with respect to the 2018-2019 dataset are listed in Table 16.

7. Disclaimer and data limitations

Disclaimer: This report has been produced for Green Adelaide using the data originally presented in *LiDAR derived tree canopy coverage metrics across Adelaide, South Australia – Report 2: Metropolitan Adelaide* (Aerometrex, 2020). This data was reprocessed to ensure greater consistency with the 2022 data, which included reprocessing of LiDAR data from 1m x 1m resolution to 0.5m x 0.5m resolution, with results presented in *Urban tree canopy data analysis and reporting 2018-2019 – Survey Area Technical Report* (DSM GeoData, 2024).

7.1. Differences in capture methodology and technology, and data processing between previous and current capture

The reprocessing of 2018-2019 data has enabled a more accurate comparison between the datasets. However, some differences including ground control leading to small positioning differences, point cloud density, sensor technology, capture methodology and data processing, could not be controlled for and may impact the accuracy of this comparison.

7.2. Tree canopy cover change detection

For the purpose of change detection analysis, tree pruning was classified as any loss of tree canopy >4 m2 which is connected to existing tree canopy extents. As many tree canopies overlap, these are displayed in the tree canopy spatial data as a continuous tree canopy. Some areas of tree canopy loss classified as 'pruning' are due to the loss of a tree or trees, as the canopies overlapped in the previous capture or a new replacement tree has grown above 3 m. Conversely, some areas of tree canopy gain classified as 'growth' may actually be due to new plantings in an area adjacent to existing canopy.

7.3. Building change detection

Differences in the processing algorithm (raster to vector) between 2018-2019 and 2022 products created additional pixels at the edge of the products during change detection. This created isolated pixels at the edge of the building which are moved to 'unclassified' class based on minimum area criteria.

7.4. Minor rounding and methodological differences

Minor differences may be present in area calculations in some tables in this report. These are due to rounding of figures during calculation and differences in calculation methods between raster and vector spatial layers. The differences are minor and typically equate to <0.01% of the area of interest.