

# Internal Daylight Report

JDT Properties

FOR THE SITE AT:  
166 - 168 Leatherhead Road  
Chessington  
KT9 2HU

Royal Borough of Kingston upon Thames



Version	Revision	Date	Author	Reviewer	Project Manager
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## Executive Summary

## Executive Summary

The Internal Daylight Analysis has been undertaken by SRE Ltd for the Proposed Development at 166-168 Leatherhead Road, Chessington, London on behalf of JDT Properties (the client).

In accordance with standard practice and in support of planning, the Client wishes to ensure that habitable rooms within the Proposed Development, receive sufficient natural light. Modelling and calculations have been conducted following the recommended internal daylight standards as detailed in British Research Establishment (BRE) guidance “Site Layout Planning for Daylight and Sunlight” (PJ Littlefair 2022), the British Standard of practice for daylight (BS EN 17037-2018) and the Chartered Institution of Building Services Engineers (CIBSE) Lighting Guide LG 10 Daylighting and Window Design.

The assessment has been carried out for all the habitable rooms, a total of 35 no. rooms over 7 no. houses and 3 no. storeys across the scheme. To the Western boundary there’s a deep tree belt located on Council land and hence they are taken into consideration for the analysis.

The daylight simulation is based on Radiance software through the graphical user interface (GUI) of Ladybug tools 1.70 plugin in Rhino/Grasshopper. Radiance uses the backward ray-tracing method and an enhanced 2-phase method for daylight simulation which accurately models direct sun by tracing rays from each sensor to the solar position at each hour of the calculation, using a climate-based sky. Simulation results have been included in the Appendices.

Even though there are mature trees on the west boundary of the site, near houses 3-6, it will not drastically lower the internal daylight levels of the habitable spaces during winter and summer. The trees will also partially provide shade that will help avoid overheating issues during the summer.

The overall results of this study show that all 35 no. habitable rooms in the Proposed Development exceed the recommendations set out by BRE Guidelines. 4 no. of kitchen areas at the ground floor level in houses 3-6 will not be well lit under the full-leaf trees scenario. As these spaces are at the rear of well-daylit living spaces, with annual mean illuminance levels above the recommended thresholds for living spaces, this is not deemed to be significant.

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Introduction

## 1.0 Introduction

The Internal Daylight Analysis has been undertaken by SRE Ltd for the Proposed development at 166-168 Leatherhead Road, Chessington, London.

This study assesses the internal daylight distribution of all 35 no. habitable rooms within the Proposed Development. The assessment is undertaken in accordance with the British Research Establishment (BRE) and British Standard guidance.

The daylight simulation is based on Radiance software through the graphical user interface (GUI) of Ladybug tools 1.70 plugin in Rhino/Grasshopper. Radiance uses the backward ray-tracing method to calculate the Daylight Autonomy (DA) within the assessed rooms of the building.

The relevant neighbouring buildings are included in this assessment due to their distance from the Proposed Development.

### 1.1 The Application Site & Proposed Development

The Proposed Development located on 166-168 Leatherhead Road consists of 6 no. 3 bed 6 person (3B6P) houses and 1 no. 3B6P bungalow. The site is flanked by Leatherhead Road on the East, 162-164 Leatherhead Road building on the north and 170-172 Leatherhead Road building on the south. To the Western boundary, there's a deep tree belt located on Council land and backing onto Nigel Fisher Way.

**Error! Reference source not found.** shows the site plan of the Proposed Development. For further details, please see Appendix A for the submitted architectural drawings.



Figure 1 Site Plan of the proposed development (Matthew Allchurch Architects)

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## Principles and Methodology



## 2.0 Principles and Methodology

Daylighting is an important parameter for the assessment of a building's energy performance and quality of space. The human visual system is extremely well adapted to daylight and the benefits to human health are well documented. The use of daylight in buildings can significantly reduce peak energy loads associated with artificial lighting and therefore reduce the energy consumption and overall greenhouse gas emissions of the Proposed Development.

### 2.1 Daylight Autonomy (DA)

A UK National Annex to BS EN 17037 gives specific minimum recommendations for habitable rooms in dwellings in the United Kingdom. These are intended for 'hard to light' dwellings, for example in basements or rooms with significant external obstructions or with tall trees outside, or for existing buildings being refurbished/converted into dwellings. The National Annex therefore provides the UK guidance on minimum daylight provision in all UK dwellings.

Illuminance recommendations given by the UK National Annex are as follows:

- 100 lux in bedrooms.
- 150 lux in living rooms, dining and study.
- 200 lux in kitchens.

These are the median illuminances, to be exceeded over at least 50% of the assessment points in the room for at least half of the daylight hours. This is given by the Daylight Autonomy (DA).

Where a room has a shared use, the highest target should apply - subject to discretion. For example, the target for a living room could be used for a combined living/dining/kitchen area if the kitchens are not treated as habitable spaces, as it may avoid small separate kitchens in a design. For this assessment, the combined kitchen/living/dining rooms in the Proposed Development will target an illuminance level of 200 lux.

### 2.2 Methodology

This study is based on guidelines set out in the BRE Site Layout Planning for Daylight and Sunlight, A Guide to Good Practice, 2022. The assessment has been conducted using Radiance software through the GUI of Ladybug tools 1.70 plugin in Rhino/Grasshopper.

A 3D model has been built based on the latest architectural drawings.

4 no. scenarios have been performed.

1. Without trees
2. Bare branch trees
3. Full-leaf trees
4. Full-leaf trees, but excluding from the analysis the kitchen areas at houses 3-6, as they are located towards the rear to well-daylit living rooms.

A perspective view of the model can be seen in Figure 2 and Figure 3.

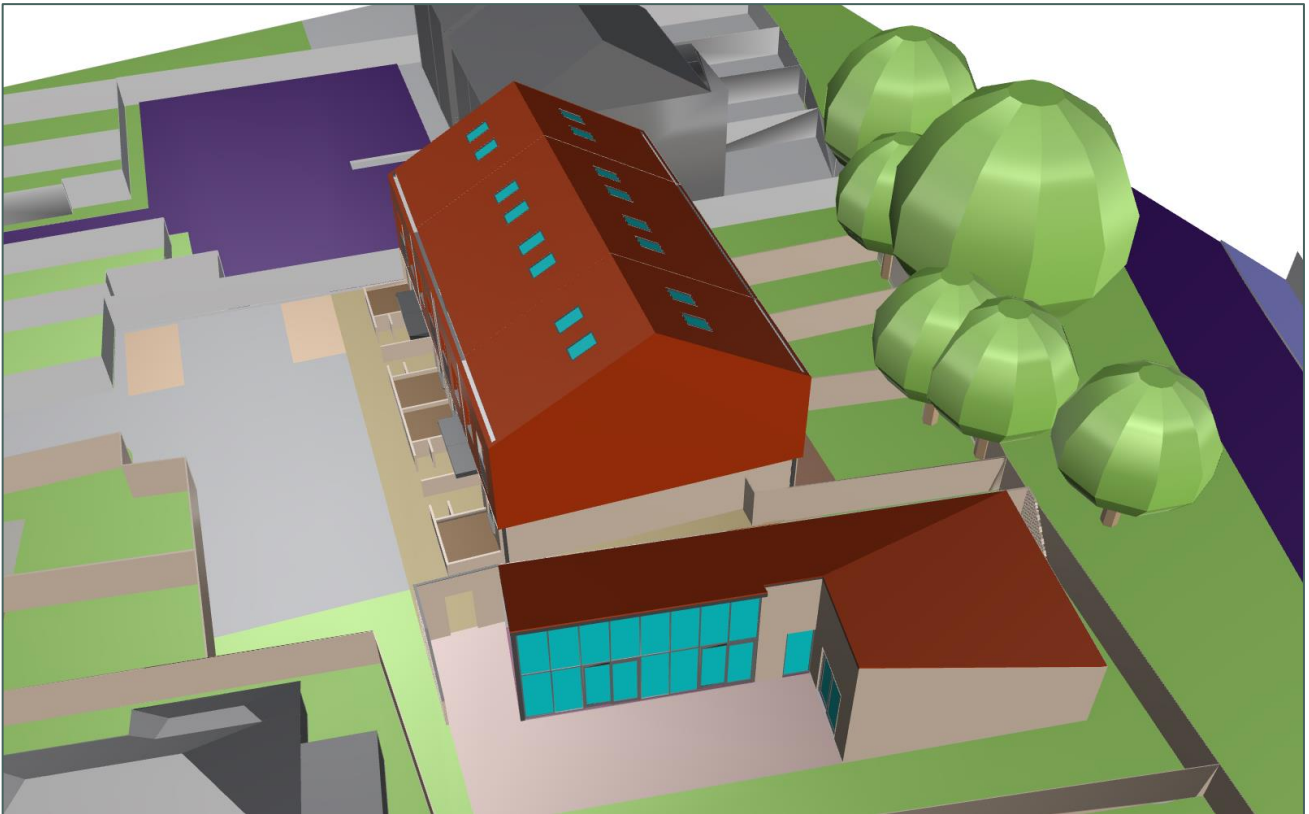


Figure 2 - Perspective view of the model from the North



Figure 3 - Perspective view of the model from the Northwest

The simulations assess Daylight Autonomy of all the habitable rooms, a total of 35 no. rooms over 3 no. storeys across the scheme.

Key points of the simulation are listed below:

- Tested on a horizontal plane at 0.85 m above the floor,
- Grid size of 0.25m,
- Margin of 0.30m from the internal walls,
- Room surface maintenance factor of 0.9, and
- Under a climate-based sky (CIBSE 2016 London TRY)

Table 1 shows the key properties that have been applied to the 3D geometry, including reflectance of the internal surfaces and the visual light transmittance of the windows. They are based on standard 'neutral' colours that are likely to be applied on relevant elements. It should be noted that changes to these figures will influence the overall results of the assessment.

	Material	Reflectance (%)
Internal walls	Off-white plaster	70.0
Internal floor	Light grey	45.0
Internal ceiling	White painted	80.0
External dark walls	Brick walls	40.0
External light walls	Light colour	60.0
Window Frame	Light grey	35.0
External floor light colour	Light colour	70.0
External Ground	Hard Surfaces and grass	20.0
Glazing	Light transmittance 70% (including the maintenance factor) Window frame dimensions based on architectural drawings	

Table 1 – Surface properties, reflectance and light transmittance of the glazing.

The trees on the site are modelled based on transparencies of tree crowns to solar radiation mentioned in the BRE guide Table G1 and is provided in the table below. As they are deciduous trees, the partial shade they provide vary with time of the year and so analysis is conducted individually for the whole year using London TRY weather file and tree crown transparencies of 25% for the full leaf scenario and 65% for the bare branch scenario to examine the worst case summer and the winter scenarios.

<b>Table G1 – Transparencies of tree crowns to solar radiation</b>			
		<b>Transparency (% radiation passing)</b>	
<b>Botanical name</b>	<b>Common name</b>	<b>Full leaf</b>	<b>Bare branch</b>
<i>Acer pseudoplatanus</i>	Sycamore	20	60
<i>Acer saccharinum</i>	Silver maple	15	55
<i>Aesculus hippocastanum</i>	Horse chestnut	20	55
<i>Betula pendula</i>	European birch	20	55
<i>Fagus sylvatica</i>	European beech	20	45*
<i>Fraxinus excelsior</i>	European ash	25	65
<i>Gleditsia</i>	Locust	30	80
<i>Quercus robur</i>	English oak	20	55*
<i>Tilia cordata</i>	Lime	10	55
<i>Ulmus</i>	Elm	15	65

\* The beech, and some oaks, tend to retain dead leaves for much of the winter, reaching bare branch condition only briefly before new leaf growth in the spring. The transparency value for beech is an average winter value.

Table 2 - Tree Crown transparencies as per BRE Guide



## Results and Conclusions

### 3.0 Results and Conclusions

The Daylight Analysis was carried out for a total of 35 no. rooms over 3 no. storeys across the scheme, the results as below.

#### 3.1 Scenario 1. Without Trees

The results from Table 3 below shows that all the assessed habitable spaces are passing the internal daylighting recommendation set by BRE Guidelines without taking into consideration the shade provided by the trees.

House	Room Activity	DA Threshold (lux, 50% of the Daylight Hours for 50% of the Area)	DA (%)	Result
House 1	Bedroom 1	100.00	100.00	Pass
	Bedroom 2	100.00	100.00	Pass
	Bedroom 3	100.00	100.00	Pass
	Kitchen/Living/Dining	200.00	62.20	Pass
	Study/Snug	150.00	100	Pass
House 2	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	61.91	Pass
	Study/Snug	150.00	100	Pass
House 3	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	63.11	Pass
	Study/Snug	150.00	100	Pass
House 4	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	68.45	Pass
	Study/Snug	150.00	99.67	Pass
House 5	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	68.74	Pass
	Study/Snug	150.00	100	Pass
House 6	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	71.74	Pass
	Study/Snug	150.00	100.00	Pass
House 7	Bedroom 1	100.00	100.00	Pass

House	Room Activity	DA Threshold (lux, 50% of the Daylight Hours for 50% of the Area)	DA (%)	Result
	Bedroom 2	100.00	100.00	Pass
	Bedroom 3	100.00	100.00	Pass
	Kitchen/Living/Dining	200.00	100.00	Pass

Table 3 – Annual Daylight Availability (DA %) analysis results

### 3.2 Scenario 2. Tree Crown Transparency of 65%, Bare Branch Trees

The results from Table 4 below shows that all the assessed habitable spaces are passing the internal daylighting recommendation set by BRE Guidelines with bare branch trees, tree crown transparency of 65%.

House	Room Activity	DA Threshold (lux, 50% of the Daylight Hours for 50% of the Area)	DA (%)	Result
House 1	Bedroom 1	100.00	100.00	Pass
	Bedroom 2	100.00	100.00	Pass
	Bedroom 3	100.00	100.00	Pass
	Kitchen/Living/Dining	200.00	61.31	Pass
	Study/Snug	150.00	100	Pass
House 2	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	62.5	Pass
	Study/Snug	150.00	100	Pass
House 3	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	54.19	Pass
	Study/Snug	150.00	100	Pass
House 4	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	55.65	Pass
	Study/Snug	150.00	99.67	Pass
House 5	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	53.56	Pass
	Study/Snug	150.00	100	Pass
House 6	Bedroom 1	100.00	100	Pass

House	Room Activity	DA Threshold (lux, 50% of the Daylight Hours for 50% of the Area)	DA (%)	Result
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	51.51	Pass
	Study/Snug	150.00	100.00	Pass
House 7	Bedroom 1	100.00	97.90	Pass
	Bedroom 2	100.00	100.00	Pass
	Bedroom 3	100.00	100.00	Pass
	Kitchen/Living/Dining	200.00	100.00	Pass

Table 4 – Annual Daylight Availability (DA %) analysis results

### 3.3 Scenario 3. Tree Crown Transparency of 25%, Full Leaf Trees

The results from Table 5 below shows that the vast majority of assessed habitable rooms pass the internal daylighting recommendation set by BRE Guidelines. Only 4 no. (11.76%) out of the total 35 no. assessed rooms, the combined kitchen/living/dining rooms at the ground floor of house 3-6, fail the assessment with full leaf trees.

House	Room Activity	DA Threshold (lux, 50% of the Daylight Hours for 50% of the Area)	DA (%)	Result
House 1	Bedroom 1	100.00	100.00	Pass
	Bedroom 2	100.00	100.00	Pass
	Bedroom 3	100.00	100.00	Pass
	Kitchen/Living/Dining	200.00	61.61	Pass
	Study/Snug	150.00	100	Pass
House 2	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	61.91	Pass
	Study/Snug	150.00	100	Pass
House 3	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	38.41	Fail
	Study/Snug	150.00	100	Pass
House 4	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	35.71	Fail



House	Room Activity	DA Threshold (lux, 50% of the Daylight Hours for 50% of the Area)	DA (%)	Result
House 5	Study/Snug	150.00	99.67	Pass
	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	32.43	Fail
House 6	Study/Snug	150.00	100	Pass
	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	27.99	Fail
House 7	Study/Snug	150.00	100.00	Pass
	Bedroom 1	100.00	76.92	Pass
	Bedroom 2	100.00	100.00	Pass
	Bedroom 3	100.00	100.00	Pass
	Kitchen/Living/Dining	200.00	100.00	Pass

Table 5 - Annual Daylight Availability (DA %) analysis results

As the kitchen is located to the rear of the space, one more calculation was performed, including only the living and the dining areas with a target illuminance level of 150 lux.

### 3.4 Scenario 4. Tree Crown Transparency of 25%, Full Leaf Trees (excluding 4 no. ground floor kitchen spaces in houses 3-6)

The results from Table 6 below shows that all the assessed spaces are passing the internal daylighting recommendation set by BRE Guidelines with full leaf trees, tree crown transparency of 25%, demonstrating that the main habitable spaces have good levels of daylight even with full-leaf trees.

House	Room Activity	DA Threshold (lux, 50% of the Daylight Hours for 50% of the Area)	DA (%)	Result
House 1	Bedroom 1	100.00	100.00	Pass
	Bedroom 2	100.00	100.00	Pass
	Bedroom 3	100.00	100.00	Pass
	Kitchen/Living/Dining	200.00	60.42	Pass
	Study/Snug	150.00	100	Pass
House 2	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Kitchen/Living/Dining	200.00	62.2	Pass
	Study/Snug	150.00	100	Pass

House	Room Activity	DA Threshold (lux, 50% of the Daylight Hours for 50% of the Area)	DA (%)	Result
House 3	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Living/Dining	200.00	70.21	Pass
	Study/Snug	150.00	100	Pass
House 4	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Living/Dining	200.00	66.85	Pass
	Study/Snug	150.00	100	Pass
House 5	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Living/Dining	200.00	64.96	Pass
	Study/Snug	150.00	100	Pass
House 6	Bedroom 1	100.00	100	Pass
	Bedroom 2	100.00	100	Pass
	Bedroom 3	100.00	100	Pass
	Living/Dining	200.00	58.19	Pass
	Study/Snug	150.00	100.00	Pass
House 7	Bedroom 1	100.00	76.22	Pass
	Bedroom 2	100.00	100.00	Pass
	Bedroom 3	100.00	100.00	Pass
	Kitchen/Living/Dining	200.00	100.00	Pass

Table 6 - Annual Daylight Availability (DA %) analysis results

The overall results of this study show that all 35 no. habitable rooms in the Proposed Development exceed the recommendations set out by BRE Guidelines. 4 no. of kitchen areas at the ground floor level in houses 3-6 will not be well lit under the full-leaf trees scenario. As these spaces are at the rear of well-daylit living spaces, with annual mean illuminance levels above the recommended thresholds for living spaces, therefore this is not deemed to be significant.

Therefore, it can be concluded that the Proposed development will receive adequate internal daylight levels, which can in turn support the health, wellbeing, and productivity of the building occupants. Even though there are mature trees on the west boundary of the site, near houses 3-6, it will not drastically lower the internal daylight of the habitable spaces during winter and summer. The trees will also partially provide shade that will help avoid overheating issues.

Floor plans with the daylight results for all assessed spaces for all 4 no. scenarios, have been included in Appendix B, C, D and E.

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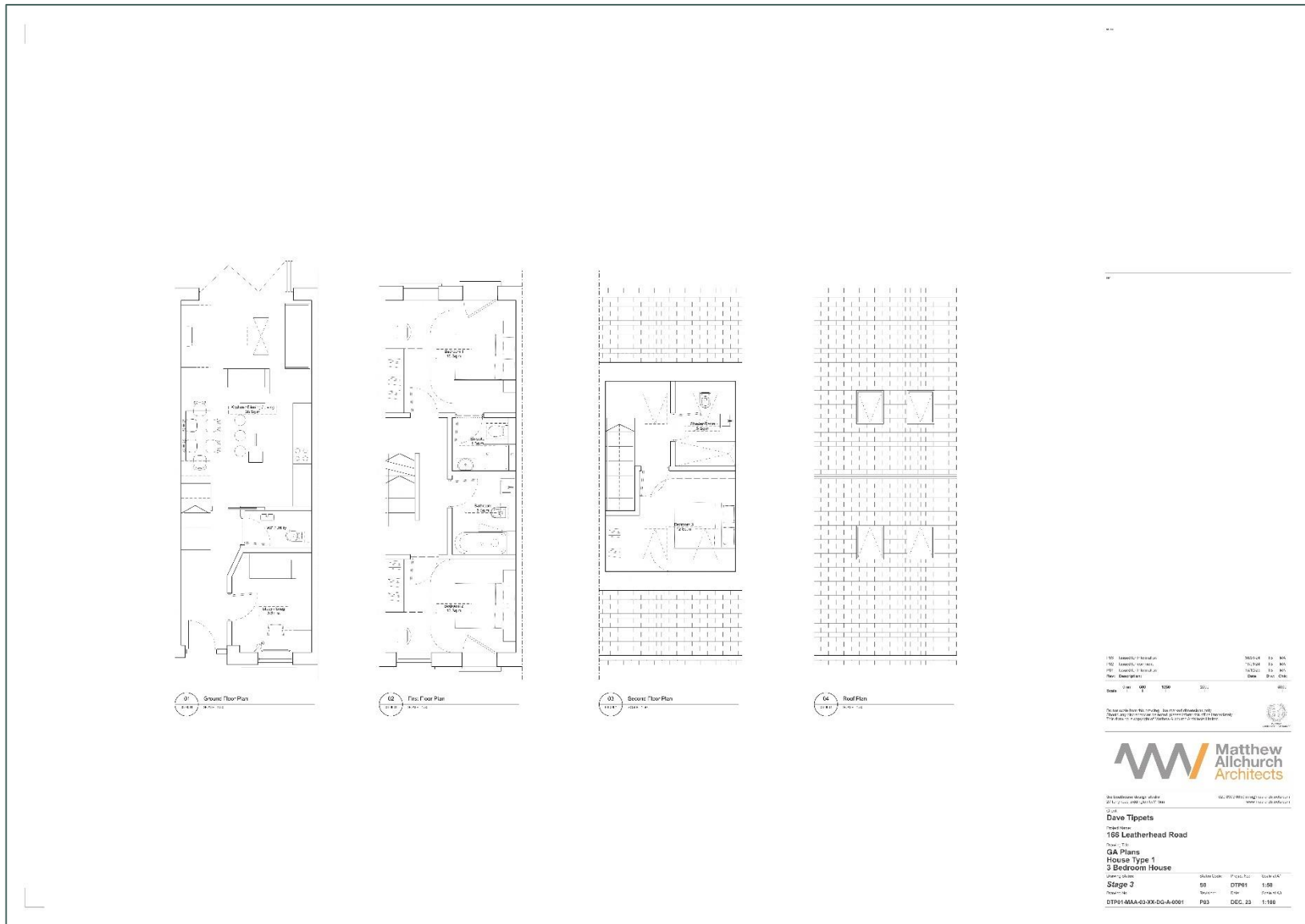
## Appendices

# Appendix A – Proposed Development Plans, Elevations and Section

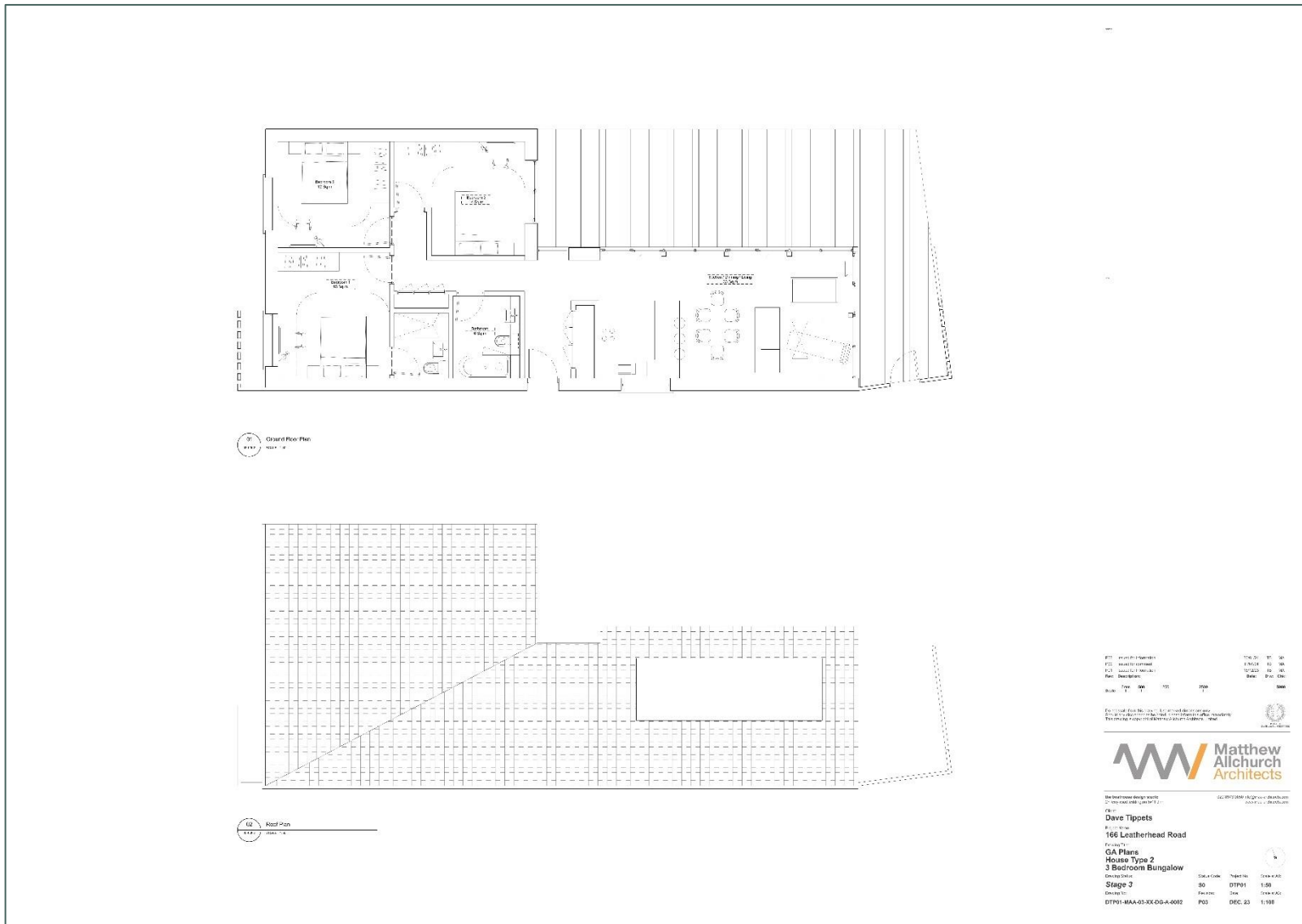
## Ground Floor Plan



Floor Plans – House Type 1



Floor Plans – House Type 2



## Appendix B – Scenario 1 - No Trees - Daylight Autonomy results in occupied rooms - Room area and assessment points in the room above threshold

### Ground Floor

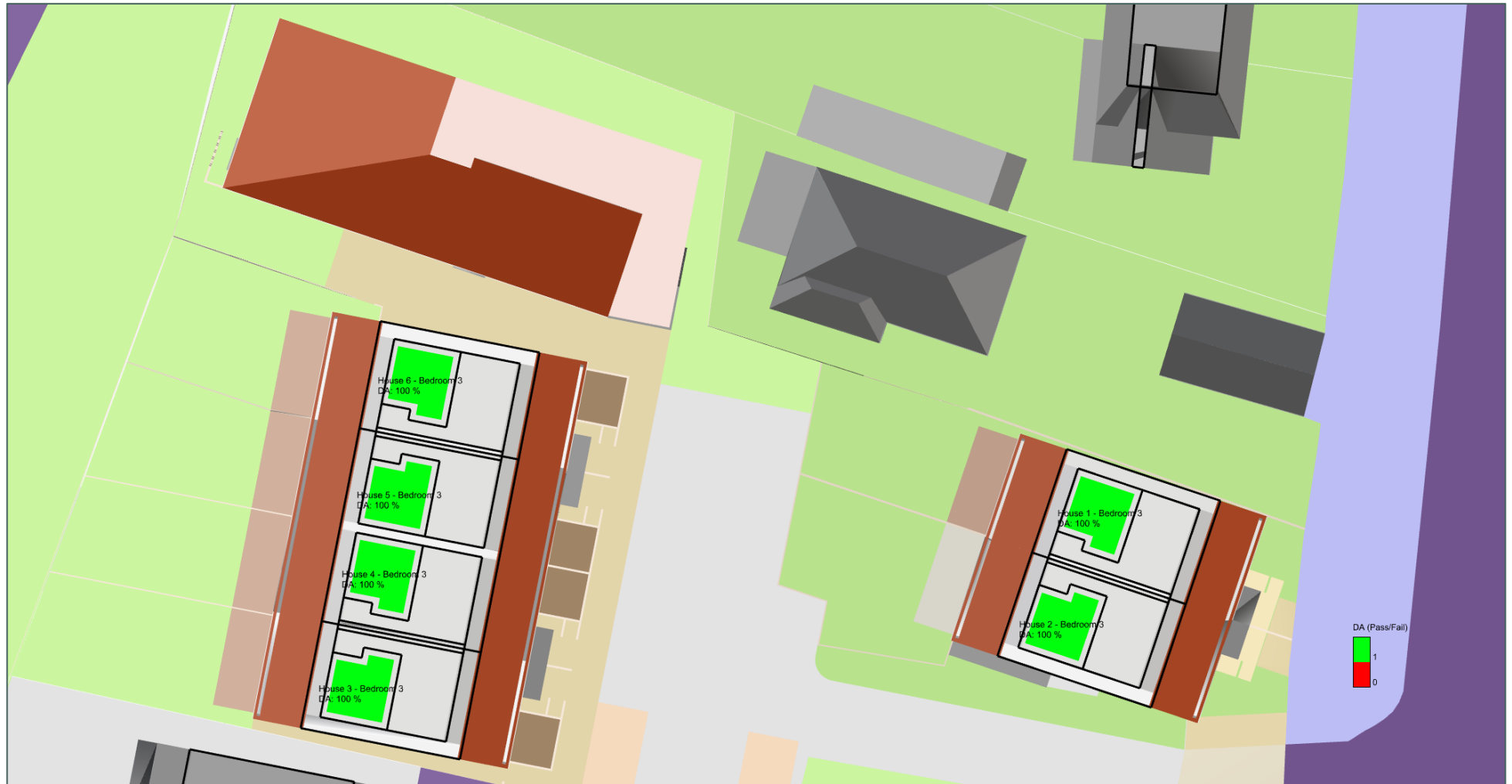


First Floor





Second Floor

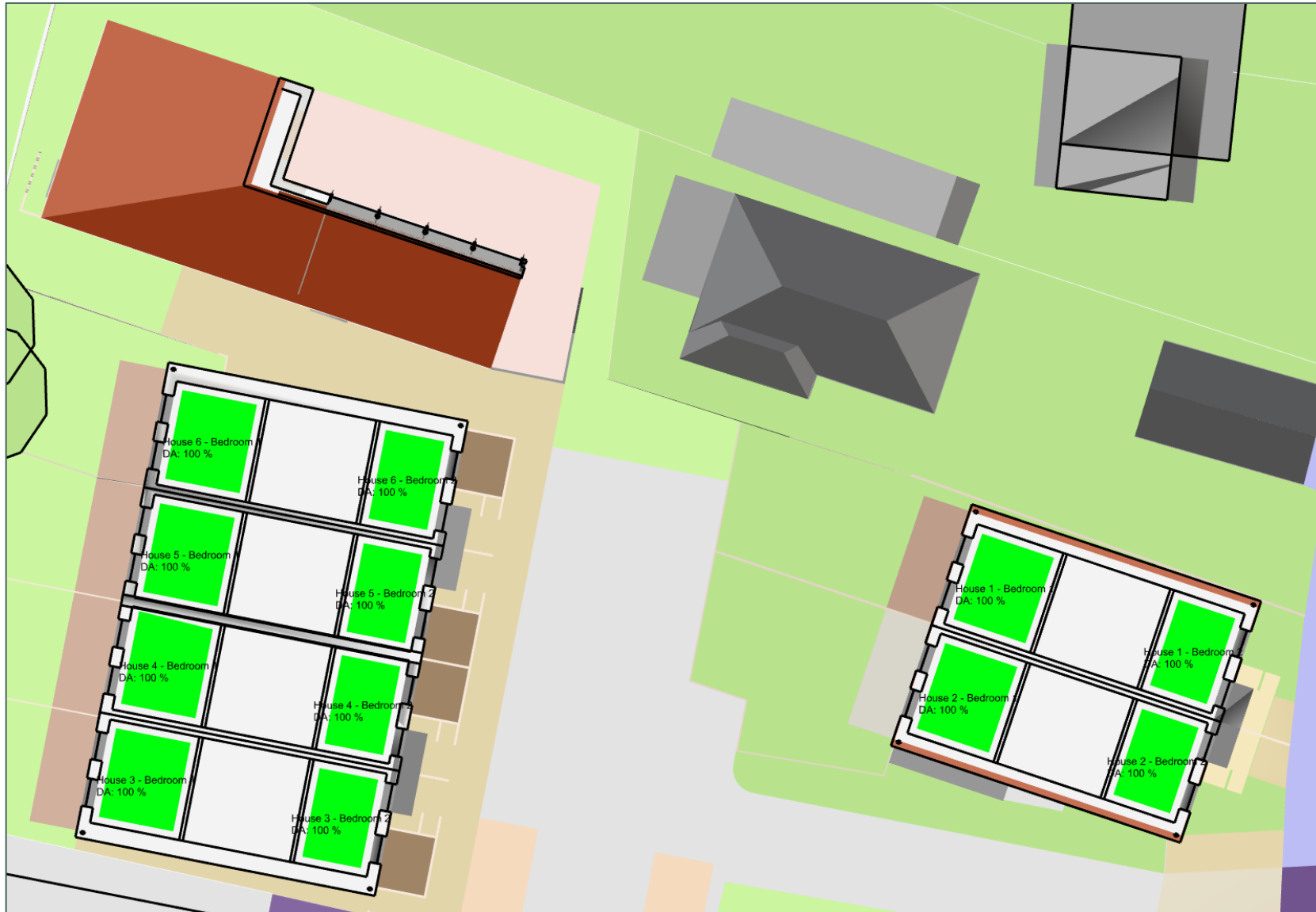


Appendix C – Scenario 2 - Bare Branch Trees, Tree Crown Transparency of 65% - Daylight Autonomy results in occupied rooms - Room area and assessment points in the room above threshold

Ground Floor



First Floor



Second Floor



Appendix D – Scenario 3 – Full Leaf Trees, Tree Crown Transparency of 25% - Daylight Autonomy results in occupied rooms - Room area and assessment points in the room above threshold

Ground Floor



First Floor



Second Floor



Appendix E – Scenario 4 – Full Leaf Trees, Tree Crown Transparency of 25% - Daylight Autonomy results in occupied rooms in the ground floor, Living/Dining space in Houses 3-6 - Room area and assessment points in the room above threshold

Ground Floor







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