# Overheating Analysis

MAA Architects

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London Borough of Richmond upon Thames

SRE

| Version | Revision | Date | Author | Reviewer | Project Manager |
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# Contents

# Executive Summary

# Executive Summary

This Overheating Report has been undertaken by SRE for the proposed residential development at Waldegrave Mews, London Borough of Richmond (the Proposed Development) on behalf of MAA Architects (the Client).

This report assesses thermal comfort measures for the Proposed Development, in order to ensure that the thermal condition within the building and the associated rooms meet the standards set out in CIBSE TM59 and TM52, and to ascertain any overheating risk that may arise.

In order to assess the thermal performance of the Proposed Development, a model of the Proposed Development has been created within the dynamic thermal analysis software IES-VE 2021. All results are based on the simulation output and should be taken as an indication of the likely final situation, but these conditions cannot be guaranteed.

This report describes the dynamic thermal modelling exercise undertaken, lists all the assumptions used and presents the results obtained.

A range of passive design measures have been incorporated where feasible, to optimise thermal comfort conditions and minimise the overheating risks through a combination of shading device, openable windows and efficient lighting.

The overheating risks and thermal comfort conditions of the spaces were assessed for current and future climate scenarios as per TM59 recommendation.

The results of the simulations indicate that under the specified weather file (DSY1 2020s high emissions, 50$^{th}$ percentile), the assessed ‘worst-case’ habitable spaces in the top floor units of the Proposed Development passes the assessment criteria, indicating a good level of thermal comfort during summer periods.

Additional simulations using a future weather file (DSY1 2050s high emissions, 50$^{th}$ percentile) have also been conducted to further test the robustness of the design. The results show that 12 out of the 16 no. assessed spaces that fail the assessment criteria, indicating an overheating risk, and adaptive measures will have to be put in place in order for good levels of thermal comfort conditions to be achieved during severe heat waves in the future. Future retrofit measures such as external shading will help keep future overheating risks to a minimum.

# Introduction

# 1.0 Introduction

This Overheating Report has been undertaken by SRE for the proposed mixed-use development at Waldegrave Mews, London Borough of Richmond (the Proposed Development).

Following the guidance of CIBSE TM59: 2017, this study assesses the Proposed Development's overheating risk in relation to the intensity of heat gains, occupancy patterns, building orientation, dwelling layout, shading strategy and ventilation methods in response to the relevant requirements for the development.

All results are based on the output from dynamic thermal simulation software IES-VE 2021, which is fully compliant with CIBSE Applications Manual AM11, and should be taken as an indication of the likely final situation. However, these conditions cannot be guaranteed.

It is important to note that with any modelling exercise there are assumptions and approximations that have to be made. As far as possible, details of all assumptions made, and approximations used are supplied as part of the report.

## 1.1 The Proposed Development

The Proposed Development consists of the construction of 18 no. new residential dwellings comprising of one and two beds at the rear of the existing premises (herby referred to as Waldegrave Mews). In addition, the existing premises at 189 Waldegrave Road will be refurbished to provide a new mixed use building providing employment space on the ground floor, with a two bed maisonette unit on the first and second floors.

The site is bounded by a railway line to the West, residential to the North and South, and a mix of residential and commercial to the East along Waldegrave Road.

Figure 1 – Proposed site map (MAA Architects)

Detailed floor plans can be found in Appendix A of the report.

## 1.2 Methodology

### 1.2.1 CIBSE Guide A: Environmental Design

CIBSE Guide A ‘Environmental Design’ (2015) gives general guidance and recommendations for buildings on suitable winter and summer temperatures for a range of room and building types.

Table 1 summarises the comfort criteria for relevant room types within the Proposed Development.

| | | Bedroom | Kitchen/Living/Dining |
|---|---|---|---|
| Winter period (Oct-Apr) | Operative | 17-19 | 22-23 |
| | Activity (met) | 0.9 | 1.1 |
| | Clothing (clo) | 2.5 | 1.0 |
| Summer period (May-Sep) | Operative | 23-25 | 23-25 |
| | Activity (met) | 0.9 | 1.1 |
| | Clothing (clo) | 1.2 | 0.65 |

Table 1 - CIBSE Guide A, recommended comfort criteria

### 1.2.2 CIBSE TM52: The limits of thermal comfort: avoiding overheating in European buildings

CIBSE TM52 is a Technical Memorandum (TM) about predicting overheating in buildings. It outlines the approach adopted by CIBSE to ensure that a building is comfortable for its occupants and how the likelihood of discomfort due to overheating can be predicted.

As summarised in Table 2, TM52 outlines three criteria to identify overheating in free-running buildings. A room that fails any two of the three criteria is classed as overheating.

| Criterion | Definition |
|---|---|
| 1 | Hours of exceedance ($H_e$):<br>The number of hours ($H_e$) during which the operative temperature is greater than the threshold comfort temperature by 1°C during the period May to September inclusive shall not be more than 3 per cent of the occupied hours. |
| 2 | Daily weighted exceedance ($W_e$):<br>The weighted exceedance ($W_e$) shall be less than or equal to 6 in any one day. |
| 3 | Upper limit temperature ($T_{upp}$):<br>The indoor operative temperature shall not exceed the threshold comfort temperature by 4°C. |

Table 2 - CIBSE TM52 Overheating Criteria

### 1.2.3 CIBSE TM59. Design Methodology for the Assessment of Overheating Risk in Homes

The performance standards set in CIBSE TM59: 2017 have been used to assess the overheating risk within the Proposed Development. Compliance is based on passing both of the following two criteria:

1. For living rooms, kitchens and bedrooms: the number of hours during which the operative temperature exceeds the threshold comfort temperature by 1°C during the period May to

September inclusive shall not be more than 3% of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).

2. For bedrooms only: the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26°C for more than 1% of occupied hours. (Note: 1% of occupied hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours will be recorded as a fail).

In addition to the above two criteria, the inclusion of corridors in the overheating analysis is mandatory where community heating pipework runs through them. The overheating test for corridors should be based on the number of annual hours for which an operative temperature of 28 °C is exceeded. Whilst there is no mandatory target to meet, if an operative temperature of 28 °C is exceeded for more than 3% of the total annual hours, then this should be identified as a significant risk within the report. In this analysis, the occupied hours of the communal corridors have been taken to be the same as the occupied hours of the living rooms. (Note: 3% of occupied hours between 9:00 and 22:00 for communal corridors is 142 hours, so 143 or more hours will be classified as a significant risk).

The overheating risk of the spaces are assessed under the CIBSE design summer year (DSY) weather files. A pass is required using the DSY1 2020s, high emissions, 50th percentile weather file. Other files including the more extreme DSY2 and DSY3 files, as well as future files (i.e. 2050s or 2080s), should be used to further test designs of particular concern, but a pass is not mandatory.

# Dynamic Model

## 2.0 Dynamic Model

The thermal modelling has been carried out using IES-VE 2021. IES-VE is a fully dynamic analysis tool which is compliant with CIBSE Applications Manual AM11. A 3D thermal model of the Proposed Development has been created based on the architectural drawings provided by the design team.

The following images are taken from the 3D IES-VE model and show the full geometry of the Proposed Development within the thermal model. As with any modelling exercise, some approximations have to be made, but care has been taken to ensure that the scale and dimensions of the model are as close as practicable to the design drawings, and that glazing areas are accurately represented.

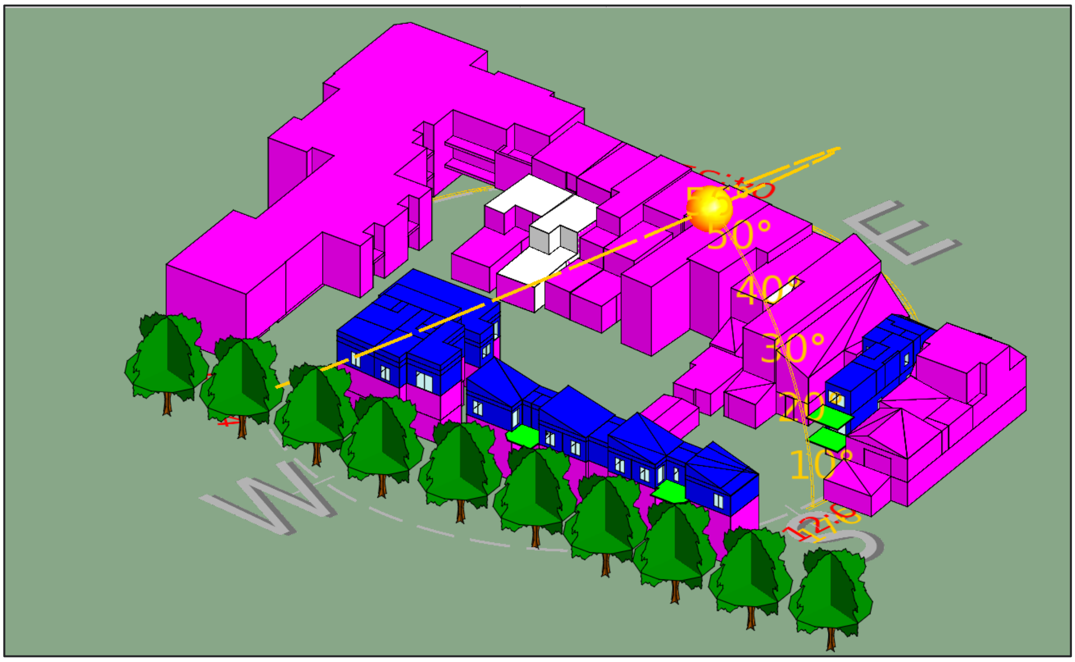



Figure 2 - Image of the 3D model in the IES-VE 2019 software, from the Southwest

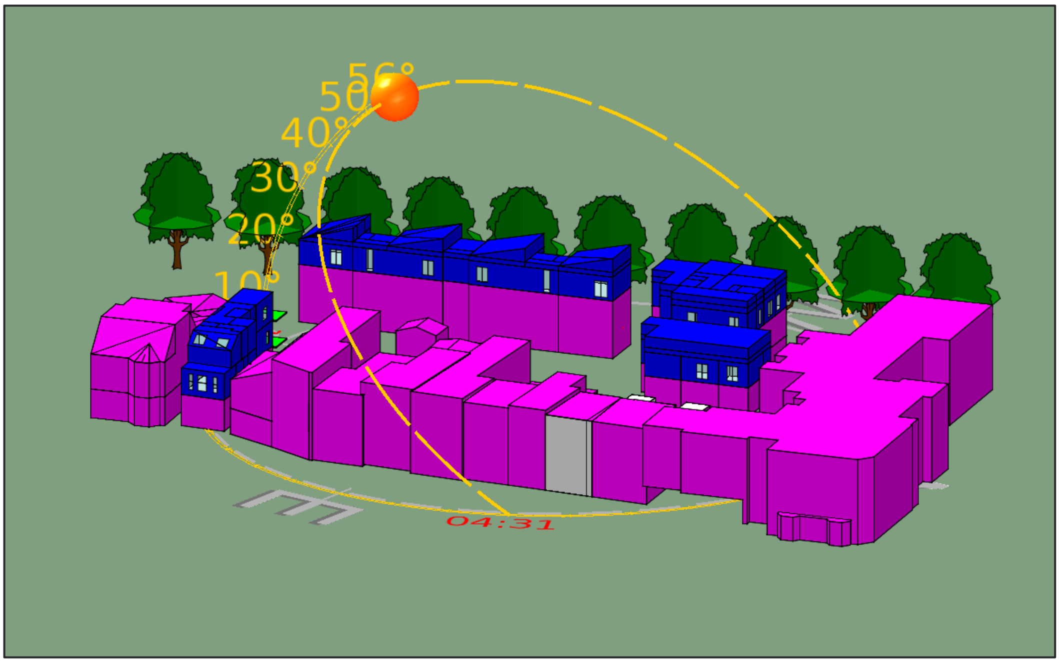



Figure 3 – Image of the 3D model in the IES-VE 2019 software, from the Northeast

For the purpose of this assessment, 16 no. habitable rooms within the 7 sample no. residential units on the top floor that are most likely to overheat are included in the detailed analysis. This represents the 'worst-case scenarios' in terms of overheating. Floor plans of the Proposed Development have been included in Appendix A-C.

The building has been divided into different zones in relation to use. Appropriate profiles and internal gains have been assigned in all different areas, but only the results of the main occupied spaces have been assessed in this study. Secondary spaces, occupied only briefly (less than 30 minutes), such as toilets, bathrooms, and cupboards are outside the scope of this study. Figure 4 shows the assessed zones. The coloured spaces indicate the different thermal and occupancy profiles applied.

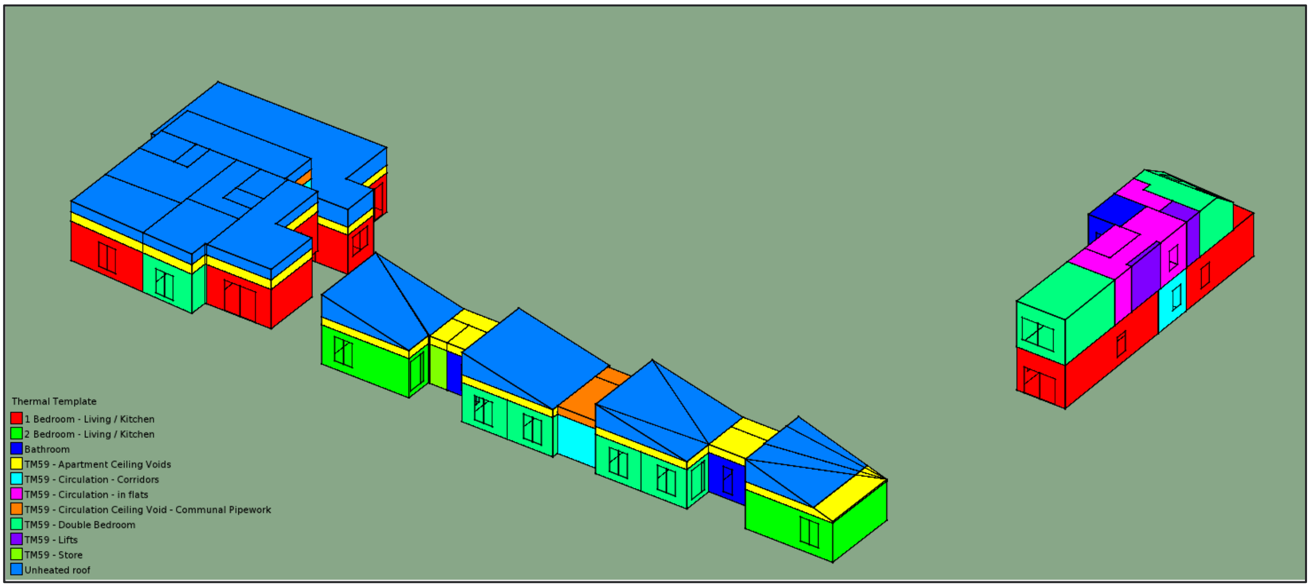



Figure 4 - Thermal zones of the assessed rooms in the Proposed Development

## 2.1 Building Fabric

High performance fabric has been specified to eliminate heat transfer between the internal conditioned areas and the ambient environment. Table 3 summarises the U-Values of all the fabric elements in the model.

| Fabric Element | U-Value |
|---|---|
| External Walls | 0.14 |
| Flat Roof | 0.11 |
| External Windows | 1.1 (g=0.40) |
| Glazed Doors | 1.1 (g=0.40) |

Table 3 - Construction details of the Proposed Development

## 2.2 Occupancy and internal gain profiles

Based on CIBSE Guide A, a maximum sensible heat gain of 75W/person and a maximum latent heat gain of 55 W/person are assumed in occupied spaces in the assessment.

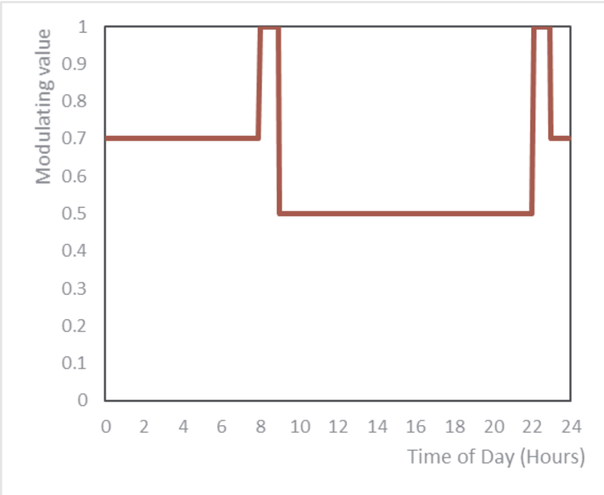
In addition, heat gains from equipment are also included in the assessment, which are summarised in Table 4. Lighting load of 2 $W/m^2$ is applied for all occupied spaces.

| Usage | Peak Load (W) |
|---|---|
| Bedroom | 80 |
| Combined Living / Kitchen | 450 |

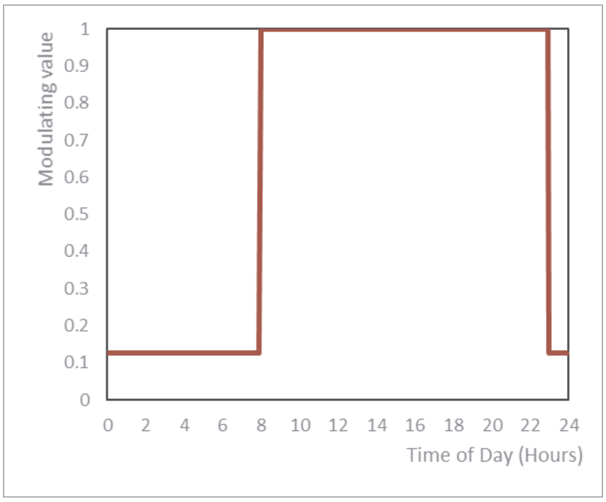
Table 4 - Equipment peak load for different usages

The occupancy and internal gain profiles have been based on the methodology described in CIBSE TM59 standard profiles according to usage, which can be seen in Table 5.

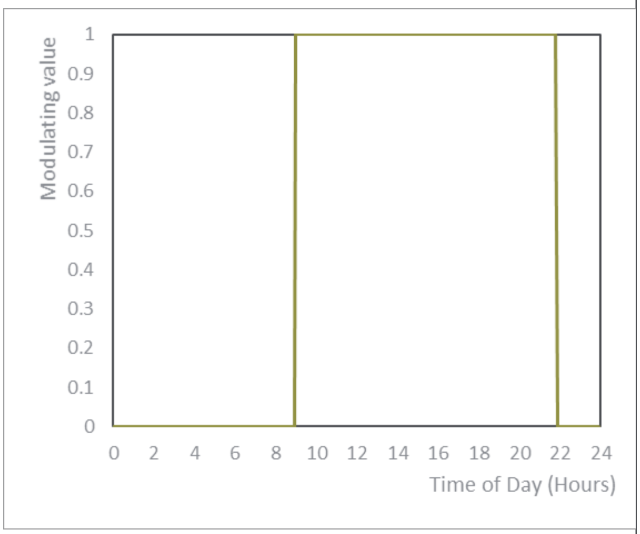
Double Bedroom Occupancy




Double Bedroom Equipment




Living/Kitchen Occupancy




Living/Kitchen Equipment

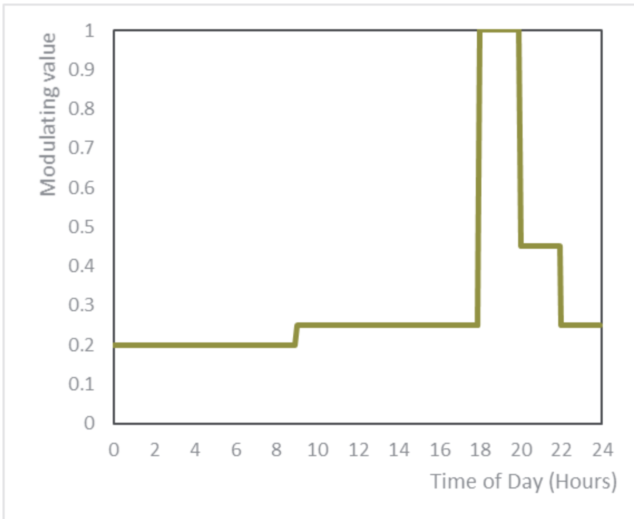


Table 5 - Occupancy and equipment profiles for the occupied space

These profiles represent a robust test that ensures the key aspects of overheating are captured, which include the following characteristics:

- Bedrooms are set with a 24-hour occupancy profile: one person is always considered in each bedroom during the daytime and two people in each double bedroom at night.
- Kitchens/living rooms are unoccupied during the sleeping hours and occupied during the rest of the day.
- No differences between weekdays and weekends are considered and the dwelling is modelled as occupied for 24 hours.

## 2.3 Air Exchange

An MVHR system with summer bypass is provided in all the dwellings. Taking into account acoustics consideration to minimise noise from the railway line directly to the west of the site and traffic from Waldegrave Road directly to the east, ventilation will be provided mainly by the MVHR system whilst keeping windows closed and only open for purge ventilation. The supply rate of the MVHR system has been modelled to run at 47l/s to provide airflow and switch to highest setting at 78l/s when internal temperatures rise above 22 °C for bedrooms and kitchen/living/dining rooms.

A design air tightness of 3 $m^3/hr/m^2$ @50 Pa has been applied in all areas. The infiltration rate is assumed at 0.25 ach.

## 2.4 Window Openings

Based on the information supplied by the Architect and taking into account acoustic considerations to minimise window openings, the specification for the opening areas are summarised in Table 6. Figure 6 shows the openable windows of the thermal model.

| Opening type | Opening category | Openable area | Max. opening angle |
|---|---|---|---|
| Top Hung Window | Top hung | 100 | 30 |
| Side Hung Window | Side hung | 100 | 90 |
| Bottom Hung Window | Bottom hung | 100 | 30 |
| Glazed Doors | Side Hung | 100 | 90 |
| Sliding Door | - | 100 | - |
| Fixed Window | - | 0 | - |

Table 6 - Glazing specification - openable areas

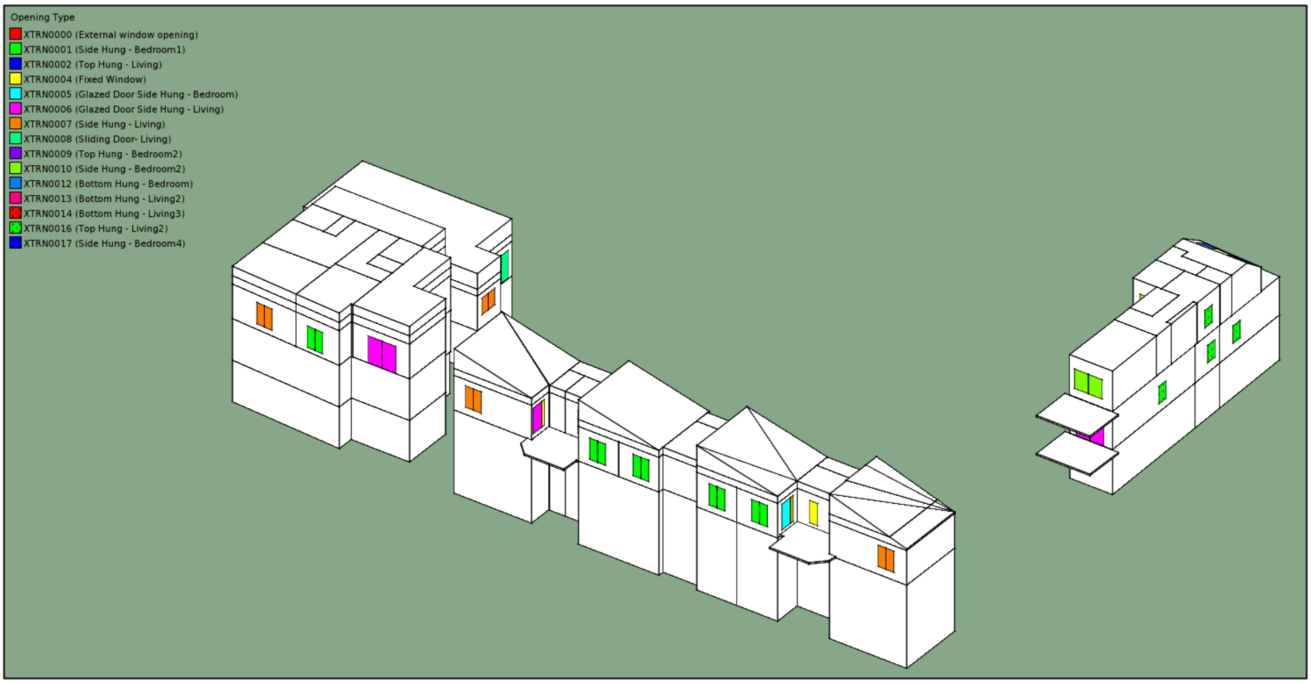



Figure 5 - Openable and fixed windows of the assessed spaces in the Proposed Development, view from the Southwest

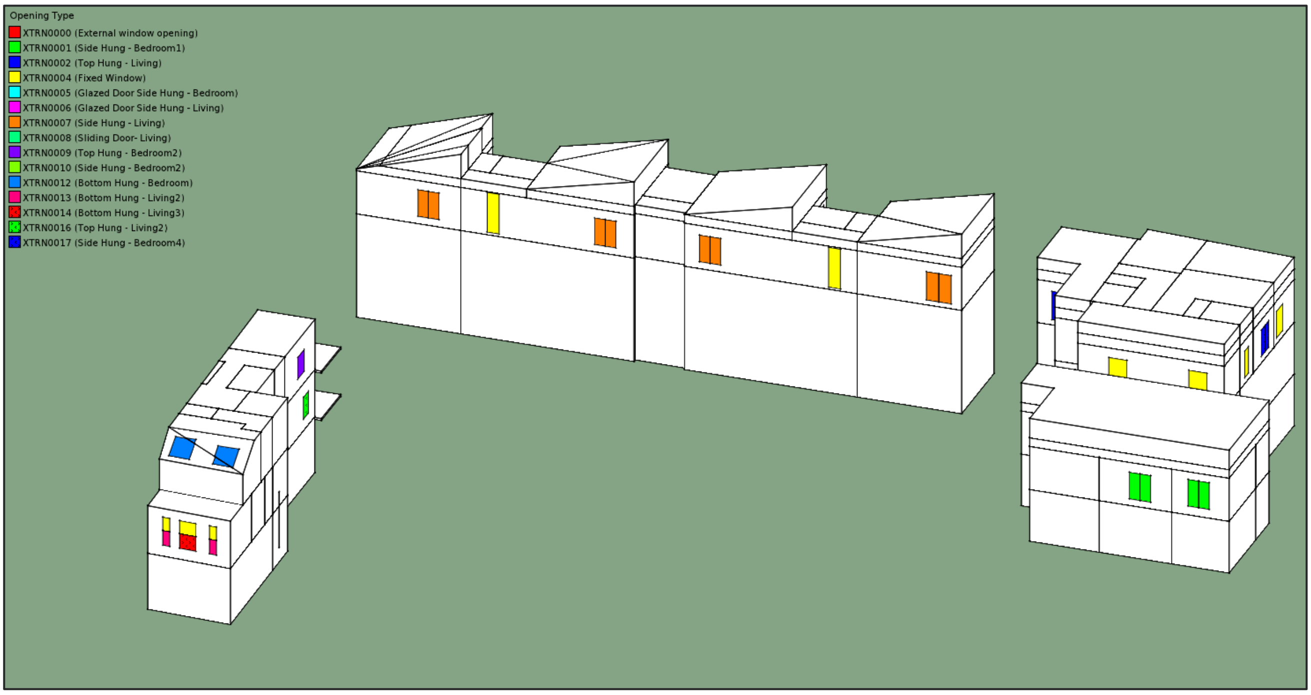



Figure 6 - Openable and fixed windows of the assessed spaces in the Proposed Development, view from the Northeast

Openable windows/doors to balcony in occupied spaces are modelled to be fully open for purge ventilation when the internal temperature reaches 24°C and the internal temperature is higher than the external temperature during occupied hours (Occupied hours for living/kitchen are from 09:00-22:00, Occupied hours for bedrooms are from 08:00-23:00). Outside of occupied hours, all windows and doors are modelled to be shut, except for the windows to bedrooms of A-03, B-06, B-07, C-07 and C-08, which are modelled to be open for purge ventilation when internal temperature reaches 24°C and the internal temperature is higher than the external temperature.

## 2.5 Shading devices

Internal blinds are applied in all non openable windows to reduce solar gains during the daytime. The blinds are assumed to be light-coloured curtain or roller blinds with a shading coefficient of 0.4 and a short-wave radiant fraction of 0.3. The blinds are scheduled to be lowered when the incident radiation is above 125 W/m$^2$ and to be raised when the incident radiation is below 100 W/m$^2$.

## 2.6 Weather File

The thermal comfort analysis is conducted under both current and projected future climate conditions, based on the below weather files:

Current condition:

- London LHR DSY1 2020s high emissions 50$^{th}$ percentile

Future condition:

- London LHR DSY1 2050s high emissions 50$^{th}$ percentile

The solar gains are calculated within the IES software based on the weather file, the building's geometry and orientation of its facades, surrounding obstacles, transmission coefficients of the glazing and the solar angles.

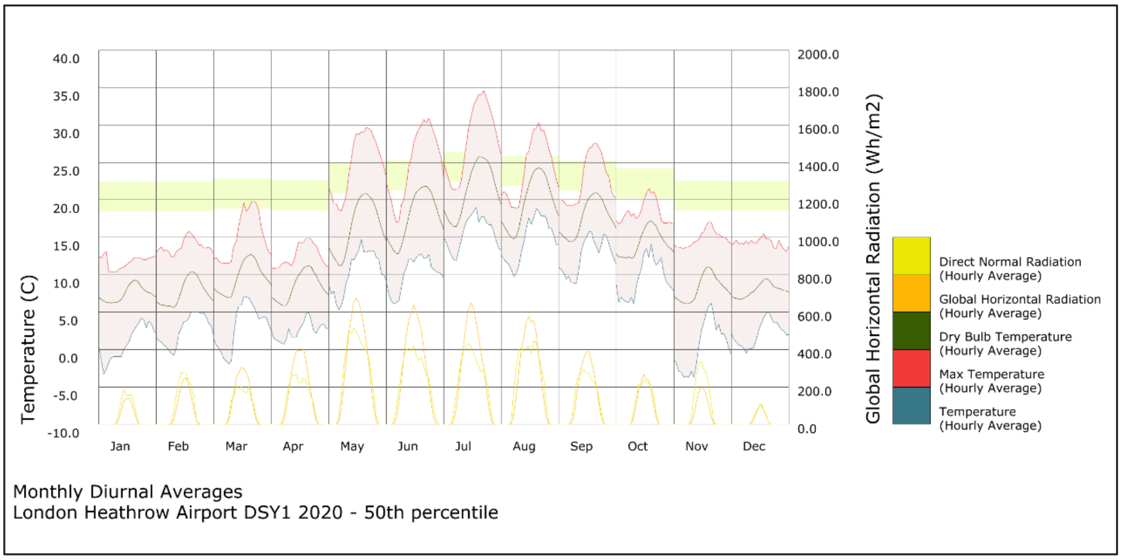



Figure 7 - Monthly diurnal averages, whole year, DSY1 2020, high emissions, 50$^{th}$ percentile weather file

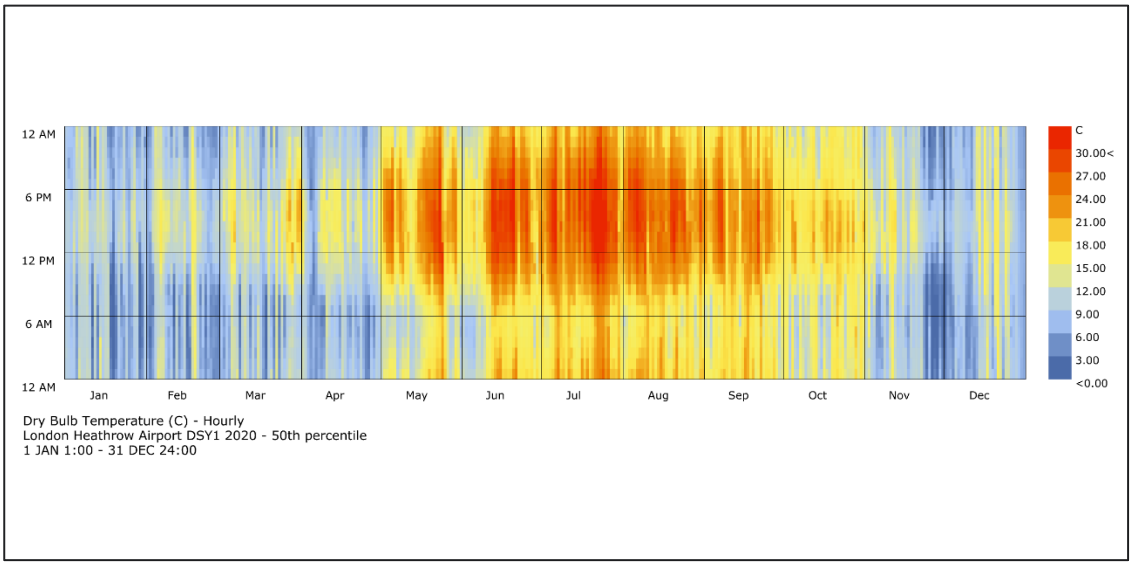



Figure 8 - Dry-Bulb Temperature, May - September, DSY1 2020, high emissions, 50th percentile weather file

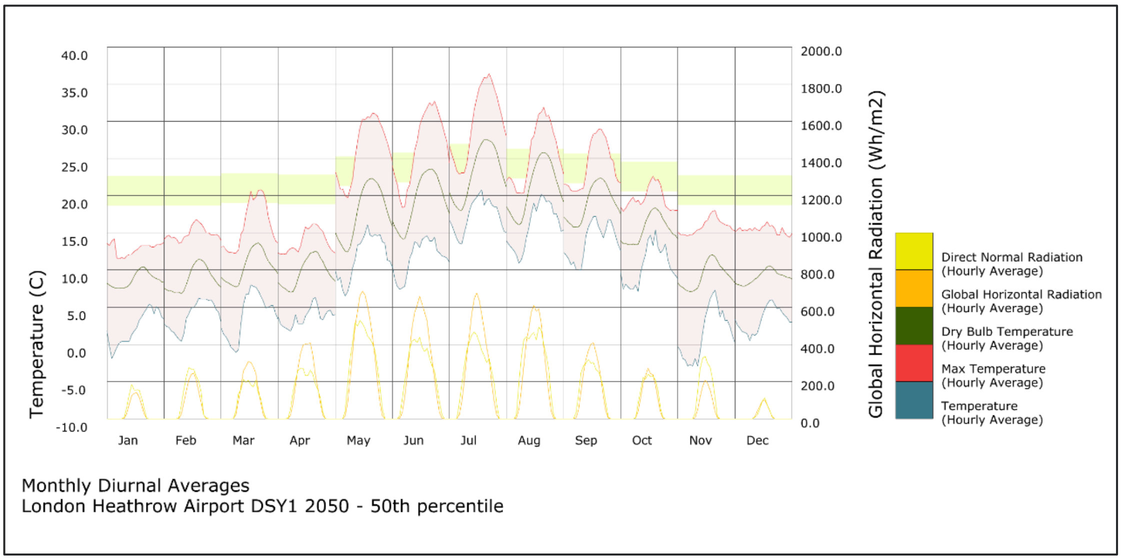



Figure 9 - Monthly diurnal averages, whole year, DSY1 2050, high emissions, 50th percentile weather file

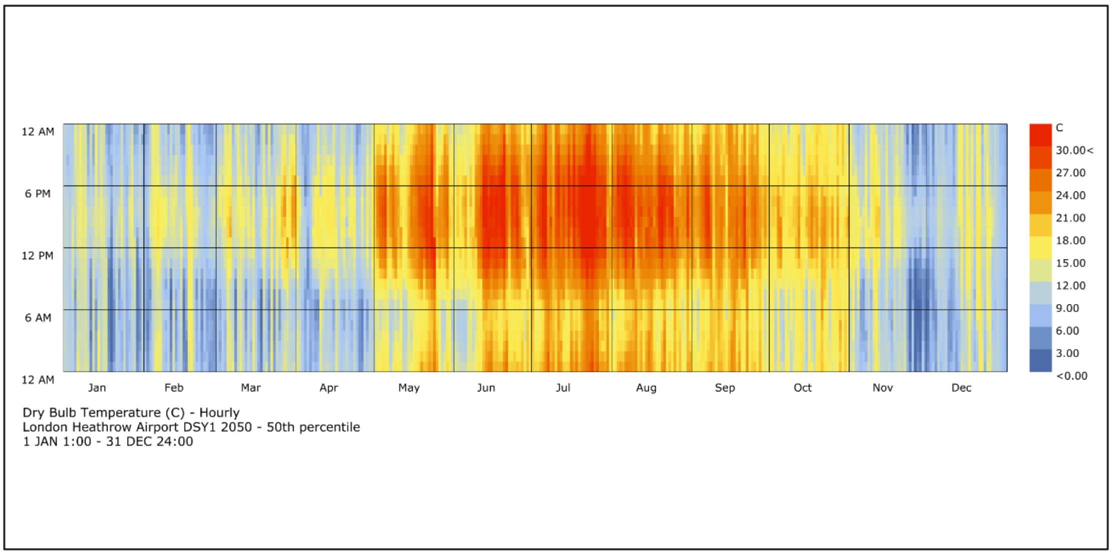



Figure 10 - Dry-Bulb Temperature, May - September, DSY1 2050, high emissions, 50th percentile weather file

# Results

# 3.0 Results

According to CIBSE TM59, the overheating assessment has been undertaken for the summer period, from 1st May to 30th September. The air speed is set at 0.5 m/s to generate operative temperature to factor in the likely use of fans, and the thermal comfort category is assumed to be Category II (new building) in the assessment.

Environmental design conditions have been selected from CIBSE Guide A 'Environmental Design', giving general guidance and recommendations for buildings on suitable summer temperatures and comfort criteria for relevant room types within the Proposed Development.

## 3.1 Current Weather File – 2020s DSY1

Dynamic thermal simulation hase been conducted with the settings described in Section 2.0. Results for current weather conditions using London LHR DSY1 2020s high emissions 50th percentile are presented in Table 7.

As demonstrated, all 16 no. of assessed rooms pass the assessment under the current weather file. Summertime overheating is therefore unlikely to arise and building users will generally feel comfortable in summer periods, based on the predicated data from the current weather file.

| Space | Block | Criterion 1 (% hours top-max>=1K) | Criterion 2 (hours operative temp. >26°C) | Pass / Fail |
|---|---|---|---|---|
| A-03 Bedroom | A | 0 | 17 | Pass |
| A-03 Living/Kitchen/Dining | A | 1.6 | - | Pass |
| A-04 Living/Kitchen/Dining | A | 1.8 | - | Pass |
| A04 Bedroom 1 | A | 1.8 | 32 | Pass |
| B-06 Kitchen/Living/Dining | B | 0.4 | - | Pass |
| B-06 Bedroom 1 | B | 2.4 | 24 | Pass |
| B-06 Bedroom 2 | B | 2.3 | 29 | Pass |
| B-07 Bedroom 1 | B | 1.9 | 28 | Pass |
| B-07 Bedroom 2 | B | 2.5 | 23 | Pass |
| B-07 Kitchen/Living/Dining | B | 0.5 | - | Pass |
| C-08 Bedroom 2 | C | 0.1 | 30 | Pass |
| C-07 Bedroom 1 | C | 0.1 | 22 | Pass |
| C-07 Living/Kitchen/Dining | C | 2 | - | Pass |
| C-06 Bedroom | C | 1.9 | 31 | Pass |
| C-06 Bedroom | C | 2.1 | 30 | Pass |
| C-06 Living Kitchen | C | 2.1 | - | Pass |

Table 7 – Simulation results summary for the assessed habitable rooms in top floor units– using the current DSY1 2020 weather file

## 3.2 Future Weather File – 2050s DSY1

In order to further test the robustness of the design, further simulations have been carried out under future weather file DSY1 2050s high emissions 50th percentile. It should be noted that a pass is not mandatory under the future weather scenario (Table 8).

| Space | Block | Criterion 1 (% hours top-max>=1K) | Criterion 2 (hours operative temp. >26°C) | Pass / Fail |
|---|---|---|---|---|
| A-03 Bedroom | A | 0.7 | 52 | Fail |
| A-03 Living/Kitchen/Dining | A | 1.2 | - | Pass |
| A-04 Living/Kitchen/Dining | A | 1.3 | - | Pass |
| A04 Bedroom 1 | A | 1 | 75 | Fail |
| B-06 Kitchen/Living/Dining | B | 4.3 | - | Fail |
| B-06 Bedroom 1 | B | 4.9 | 61 | Fail |
| B-06 Bedroom 2 | B | 4.3 | 73 | Fail |
| B-07 Bedroom 1 | B | 3.8 | 68 | Fail |
| B-07 Bedroom 2 | B | 4.8 | 61 | Fail |
| B-07 Kitchen/Living/Dining | B | 2.8 | - | Pass |
| C-08 Bedroom 2 | C | 4.1 | 87 | Fail |
| C-07 Bedroom 1 | C | 6.2 | 58 | Fail |
| C-07 Living/Kitchen/Dining | C | 3.3 | - | Fail |
| C-06 Bedroom | C | 1.6 | 84 | Fail |
| C-06 Bedroom | C | 2.4 | 81 | Fail |
| C-06 Living Kitchen | C | 2.2 | - | Pass |

Table 8 – Simulation results summary for assessed habitable rooms in top floor units - using the future DSY1 2050 weather file

As demonstrated, only 4 out of the 16 no. of assessed rooms pass the assessment under the future weather file, with remaining 12 no. rooms failing. Therefore, summertime overheating may arise in the assessed spaces and adaptive measurs will have to be put in place for good levels of thermal comfort conditions to be achieved during severe heat waves in the future. With the inclusion of retrofit measures such as external shading, this will help minimise overheating risks in the future. It should be noted that a pass is not mandatory under future weather conditions.

# Conclusions

## 4.0 Conclusions

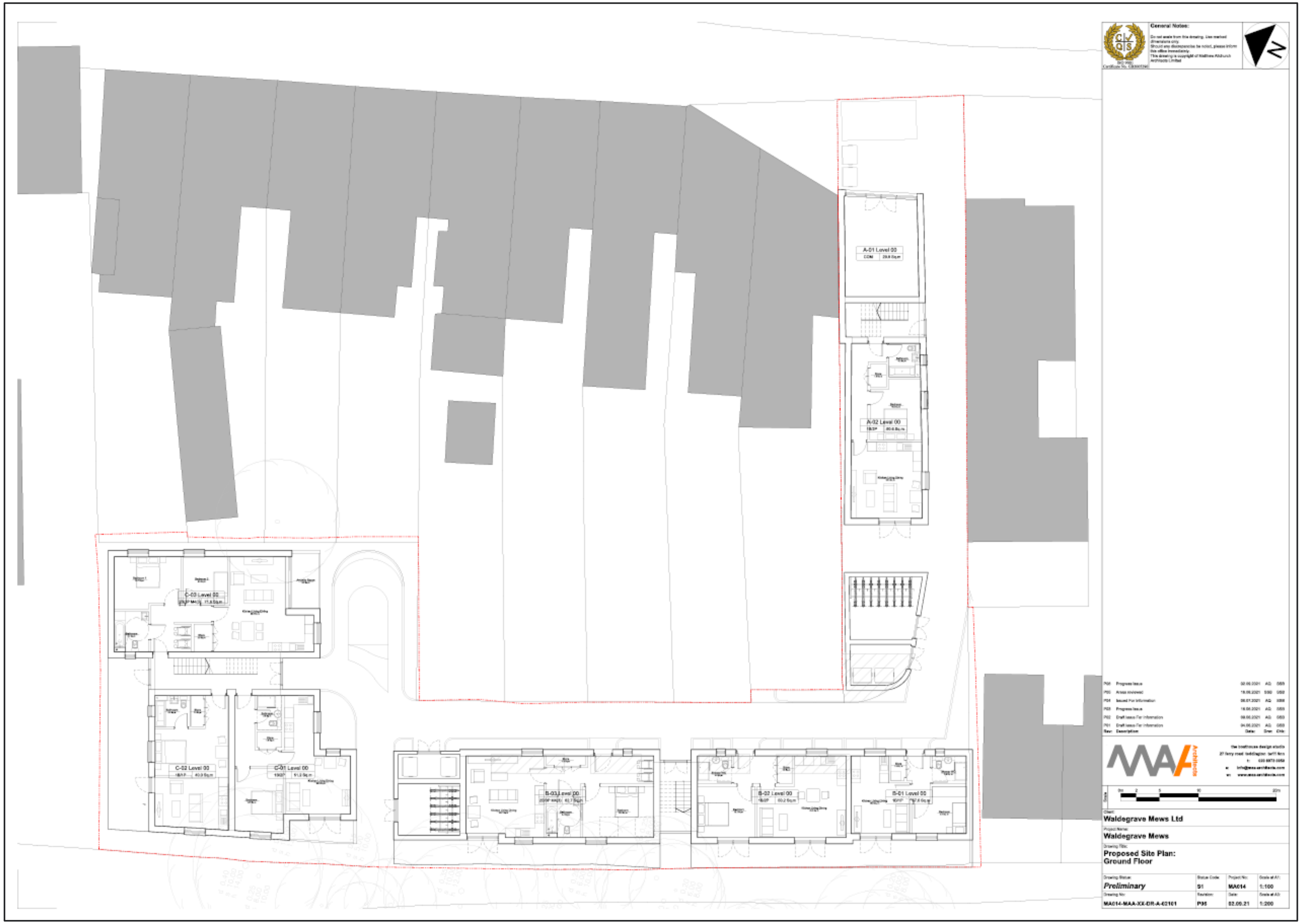
This Overheating Report has been undertaken by SRE for the proposed mixed-use development at Waldegrave Mews, London Borough of Richmond in order to assess the risks of overheating and the thermal comfort conditions in the occupied areas.

Simulation results of the 'worst-case' top floor units of the Proposed Development indicate that with the proposed ventilation strategy, all the occupied rooms meet the relevant criteria outlined in CIBSE TM52 and TM59 and therefore the overheating risk is minimal under current weather with extreme summer conditions.

Additional simulations using future weather files have also been conducted. With 12 out of 16 no. rooms that fail the assessment, the results indicate that summertime may arise in future summer periods and adaptive measures will have to be put in place for building users to feel comfortable. Future retrofit measures such as external shading will help minimise future overheating risks in extreme weather scenarios.

# Appendices

## Appendix A – Ground Floor Plan



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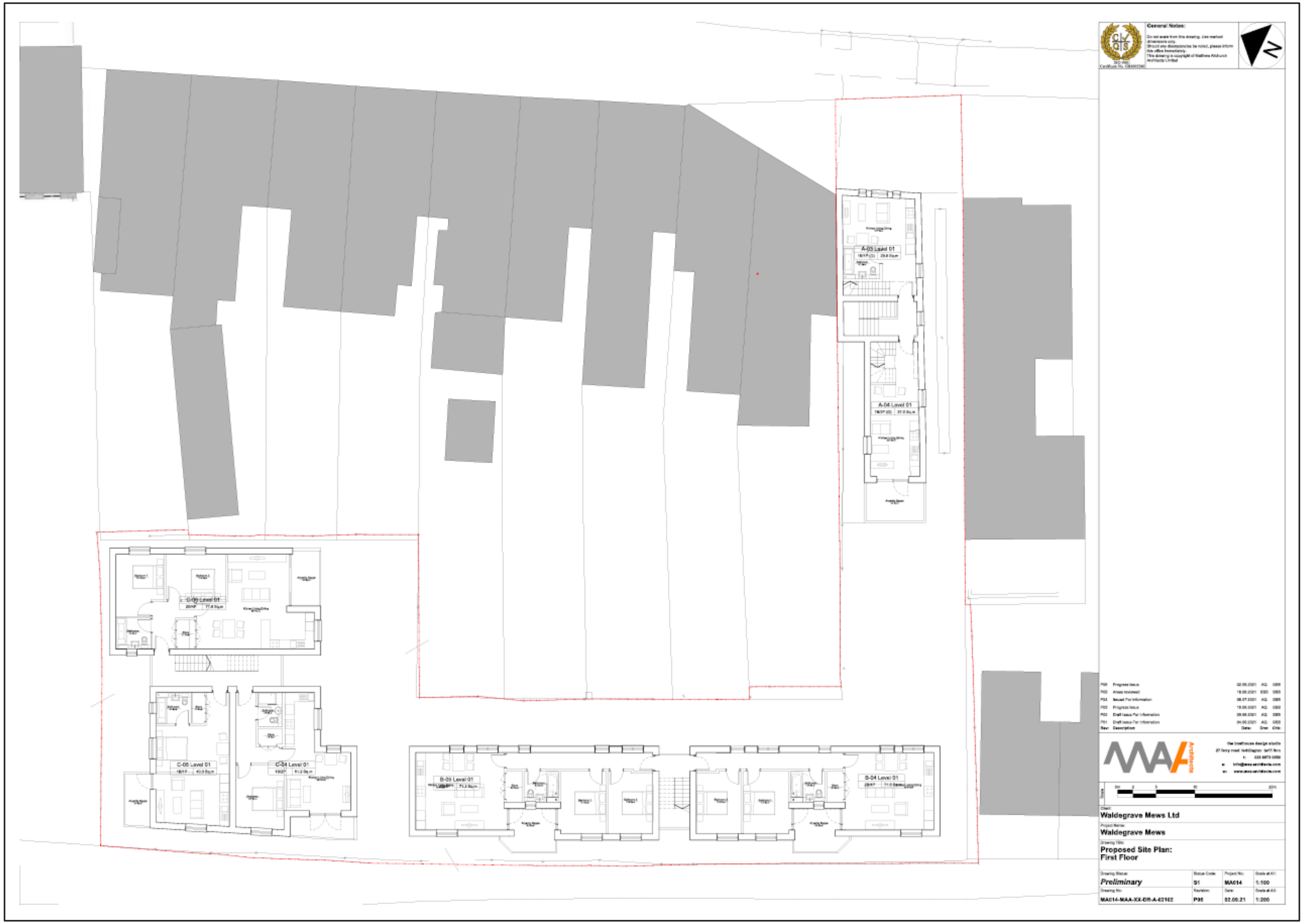
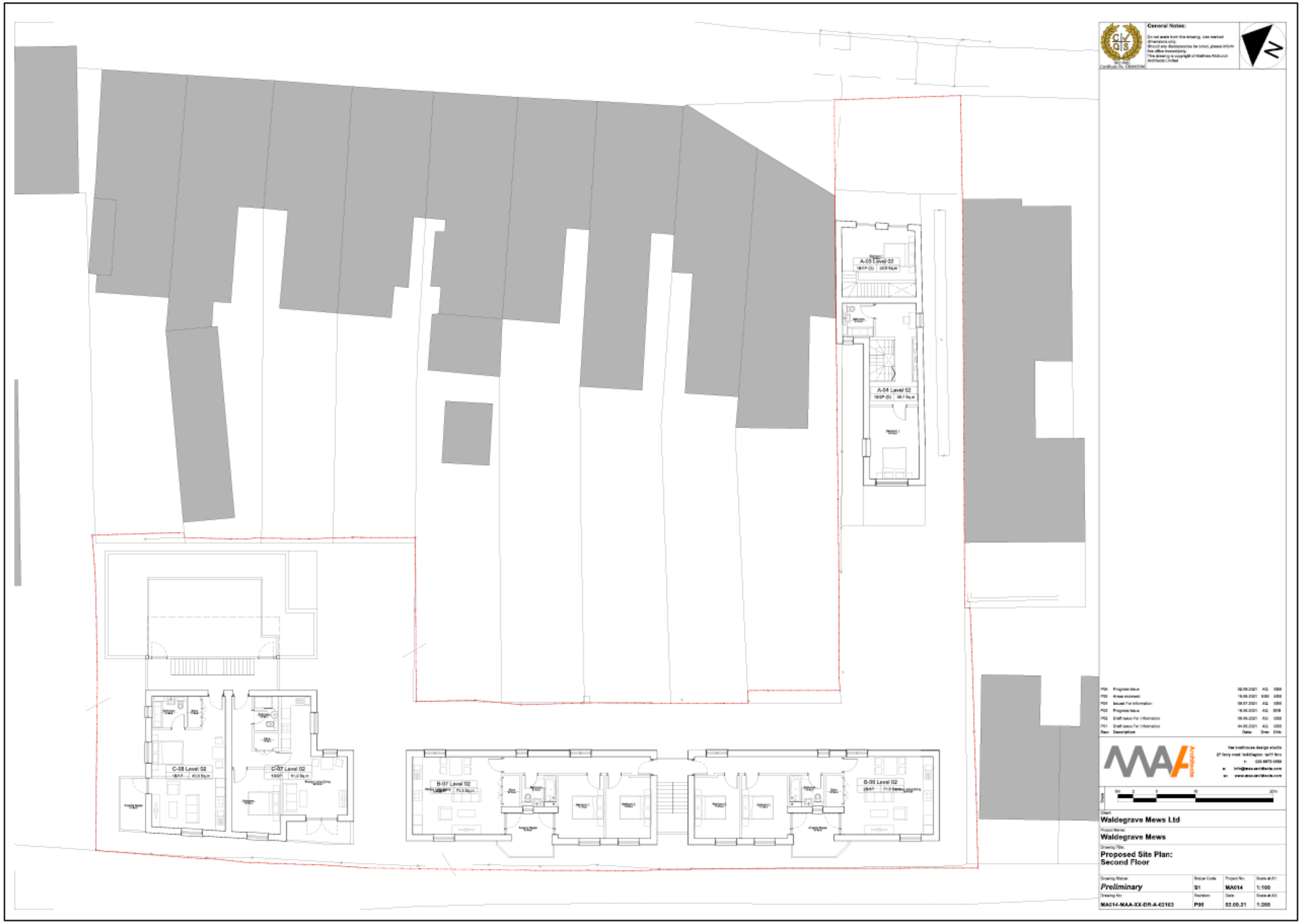
## Appendix B – First Floor Plan



# Appendix C – Second Floor Plan



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