



CWC

crookes walker
consulting

Medicines Evaluation Unit

Wythenshawe,
Manchester

Environmental Standards
Statement

Date: 04/04/2024

Ref: 3153-CWC-XX-XX-RP-ME-0001

Revision Record

Date	Reference	Revision	Prepared By	Checked By	Authorised By
13/01/2024	3153-CWC-XX-XX-RP-ME-0001	P01	Mateusz Pulinski	Saifullah	Print Name
			MP	S	Sign
04/04/2024	3153-CWC-XX-XX-RP-ME-0001	P02	Mateusz Pulinski	Saifullah	Print Name
			MP	S	Sign

Contents

1.0	Executive Summary.....	4
1.1	CIBSE TM52 (OVERHEATING)	4
1.2	ENERGY COMPLIANCE	5
2.0	Introduction	7
3.0	Planning Considerations.....	9
4.0	Thermal Modelling Input Parameters	10
4.1	Building Fabric	11
4.2	Weather	11
4.3	Internal Gains	11
4.4	Ventilation Strategy	14
4.5	Cooling Strategy	15
5.0	Baseline HVAC services.....	17
5.1	Mechanical Services	17
5.1.1	Heating system	17
5.1.2	Cooling System	17
5.1.3	Ventilation System.....	17
5.1.4	Domestic Hot Water	17
5.2	Electrical Services	18
6.0	Energy Compliance.....	19
6.1	Energy Demand and Associated Emissions	19
6.2	Compliant Improvement Measures and LZCGT Feasibility Study.....	19
6.3	Solar Gain Check (Criterion 3)	21
7.0	Thermal Comfort Analysis.....	24
7.1	Overview of TM52 Methodology	24
7.2	Result Analysis – Base Case.....	25
7.3	Result Analysis - Mitigation (inclusion of Hybrid VRF)	27
8.0	Conclusion.....	29
	Appendix 1 – Base Case TM52 Result.....	30
	Appendix 2 – Mitigation 1 TM52 Results.....	33

1.0 Executive Summary

Crookes Walker Consulting (CWC) have been appointed to provide thermal modelling services to assist with the Environmental Standards submission for the proposed new build extension to the existing Medicines Evaluation Unit (MEU), located at Southmoor Road, Wythenshawe Hospital, Manchester. The purpose of this report is to demonstrate compliance with and provide evidence at the current as-designed stage for:

- Energy Compliance - Part L 2021 and Manchester City Council planning.
- CIBSE TM52 overheating standard.

The above consists of an assessment for energy and thermal comfort standards.

1.1 CIBSE TM52 (OVERHEATING)

The TM52 guidance is a stand-alone document that allows for prediction of overheating risk for both new and existing buildings. The standard seeks to ensure that a building is comfortable for its occupants and mitigating factors have been applied to ensure overheating risk is minimised.

Compliance with TM52 guidance is achieved if two of the following criteria are met:

1. The hours of exceedance (%He) during which ΔT exceeds 1°C shall not exceed 3% of occupied hours.
2. The daily weighted exceedance (We) shall be less than 6 hours per day for any one day.
3. The upper temperature limit (Tupp) states that ΔT shall not exceed 4°C at any one time.

The results of the baseline design stage model demonstrated that there is overheating risk within some occupied rooms as summarised in Table 3 below, and further mitigation were needed to meet TM52 overheating assessment.

Table 1 - TM52 Results (Baseline)

TM52 Compliance Count	Pass	30
	Fail	16

To achieve compliance with the TM52 methodology, the following improvements were incorporated into design:

1. Introduce Hybrid VRF cooling to previously naturally ventilated overnight stay rooms and Consulting/Examination (C/E) rooms.

The above additions allowed for all occupied rooms to demonstrate low overheating risk, thus complying with the CIBSE TM52 methodology.

Table 2 - TM52 Results (Proposed Design– Inclusion of Hybrid VRF)

TM52 Compliance Count	Pass	46
	Fail	0

1.2 ENERGY COMPLIANCE

The initial Baseline model fails to pass Part L compliance. Thus, the following additions/alterations to the building services design were included in the Design Proposal. Those are listed below:

1. All electric panel heaters were removed from design. The C/E and monitor/overnight stay rooms were fitted with Hybrid VRF system and mechanical ventilation with heat recovery, space conditioning via LTHW FCU's, Heat pump COP = 4.01, EER = 4.36
2. SFP Improvements: AHU = 1.8, MVHR = 1.2.
3. MVHR heat recovery improved to 80%.
4. Target Air permeability improved to 3.0 m³/h.m²
5. Power Factor Correction improved to >0.95
6. Replaced certain window panes with opaque cladding panels (U-value = 0.15 W/m²K).
7. Roof U-value improvement from 0.12 W/m²K to 0.10 W/m²K.
8. Demand Control Ventilation (DCV) with CO₂ sensors with speed control, applied to all rooms served by AHU and MVHR.
9. Replace all Point of Use DHW systems with 1000L calorifier fed via ASHP (SCOP= 3.87). Storage heat Loss equal to or better than 176W (4.224 kWh/day).
10. Where default lighting was modelled previously (100lm/cW), these were improved to 120lm/cW.
11. Lighting Controls:
 - a. Meeting Rooms have Absence Detection.

- b. Stores, Comms Room and Quiet Rooms have Presence Detection.

Additionally, the following measure were required to achieve compliance with Criterion 3:

1. Window G-value improved to 0.25 for south-facing occupied spaces (open offices, reception, bedrooms), as well as west-facing Volunteers Lounge.
2. Atrium glazing G-value reduced to 0.24.
3. Reception area provided with shading by moving the front façade glazing inwards to create a 1.5m overhang.
4. Atrium shading structure was removed, and the following shading elements were incorporated according to architects proposal:
 - a. 1000mm horizontal louvres at every transom level
 - b. A 600mm band of vertical louvres above every transom level
 - c. A 900mm band of vertical louvres to the entrance area

Upon implementing these improvements, the final model is compliant and passes the Part L regulations. The results of this model are provided below:

Table 3 - Improvement Strategy Results Summary

Description	TER (kgCO ₂ /m ² .yr)	BER (kgCO ₂ /m ² .yr)	TPER (kWh/m ² /yr)	BPER (kWh/m ² /yr)	Compliance Achieved?
Proposed Extension – Improvement Strategy	7.61	7.47	82.96	81.54	Yes

2.0 Introduction

Crookes Walker Consulting has been commissioned to provide dynamic thermal simulation for the proposed new extension to the current Medicines Evaluation Unit (MEU) at Wythenshawe Hospital, Manchester. The purpose of this report is to demonstrate compliance at the current as-designed stage for the following regulations and standards:

- Energy Compliance: Part L 2021 and Manchester City Council planning requirements.
- Overheating: CIBSE TM52 methodology.

The thermal modelling works have been carried out using the dynamic thermal modelling package; Virtual Environment (VE), developed by Integrated Environmental Solutions (IES) and applied in accordance with CIBSE AM11 "Building Energy and Environmental Modelling".

Analysis has been carried out at the Stage 3 design stage to demonstrate compliance with the latest energy standards for England and Manchester, highlighting energy savings and sustainable design features that have been considered in accordance with planning policy. From the energy statement for the development, an estimate for the predicted energy consumption and associated carbon emissions is documented.

In addition, the current design has been assessed to identify overheating risk, in line with CIBSE TM52 guidance.

Sustainable design in the built environment is a three-stage hierarchical process, as detailed in Table 4 below:

Table 4 - Three-stage Sustainable Design Hierarchy

Passive Design	Reduce Energy Demand – The team should first seek to design out excess energy requirements by optimising certain design elements of the building. These could include; better fabric performance, reduced infiltration, solar shading, solar control devices to reduce cooling and where applicable the use of natural ventilation. This reduction in demand will result in a reduction of fuel use but may also mean smaller plant items required resulting in a greater cost saving.
----------------	--

Energy Efficiency	Reduce Energy Consumption – The building services design should incorporate efficient heat and coolth generation systems, insulated distribution systems and adequately effective system controls; electrical lighting efficacy and control should also be designed for efficient usage. The remainder energy requirements will then be quantified to analyse the most appropriate renewable energy system for the project
Low and Zero Carbon Technology	Provide Renewable Energy – The most suitable LZC technologies are selected and appraised for their likely contribution to the project. The aim is to maximise the amount of renewable energy utilisation for the project within a cost-effective manner. A summary will outline those that should be rejected and those that should be considered further during the more detailed stages of the design process.

3.0 Planning Considerations

The planning requirements described by the planning authority (Manchester City Council) which requires new developments to utilise the three-stage hierarchical process for sustainable design. Policy EN4 details the following requirements:

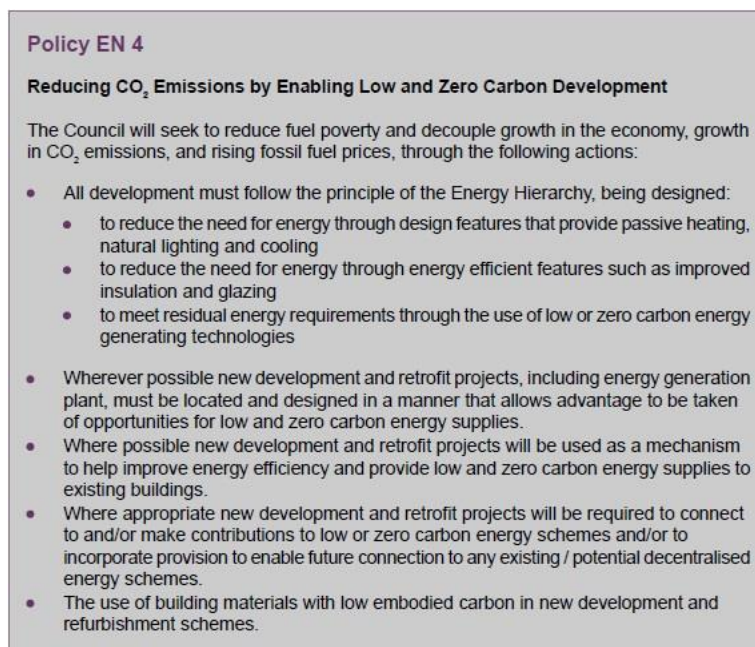


Figure 1 - Policy EN4 of Manchester Core Strategy Development Plan

Manchester City Council recommends utilising this technology as much as feasibly possible, with no specific contribution from LZCGT required. In addition, where possible, analysis should be undertaken to determine the feasibility of connecting the new extension to an existing local heat network. Figure 2 below shows that the nearest heat network plant (yellow arrow) is too far away from the proposed site to benefit from, and thus it currently is not feasible for the new extension to benefit from a local heat network.

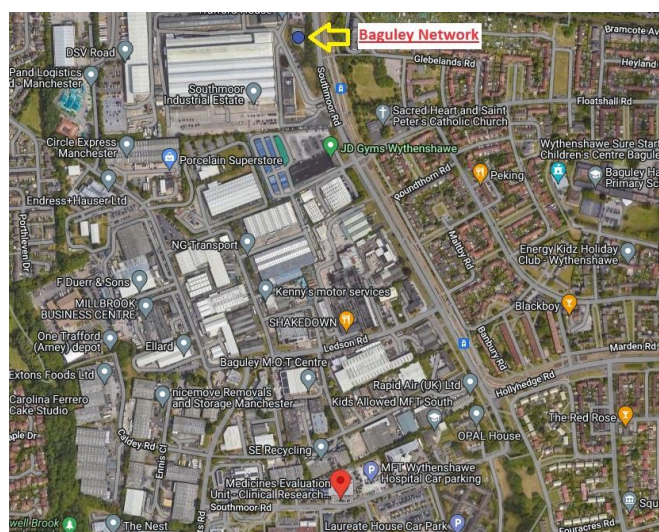


Figure 2 - Feasibility of Heat Network Connection

4.0 Thermal Modelling Input Parameters

The accredited IES VE thermal modelling package has been used to create a thermal representation of the new office fit out and has been used to inform the design process in terms of heating loads, thermal comfort conditions and energy compliance.

In the first instance a three-dimensional model of the proposed building was constructed using the “Model IT” tool in IES, based on the architectural plans and elevations. The model is a true representation of the building.

Once the geometric model is completed, certain elements such as fabric details (U values for walls, floors, roof, windows, and doors) and window openings are assigned to the model. The model for this building can be viewed below:

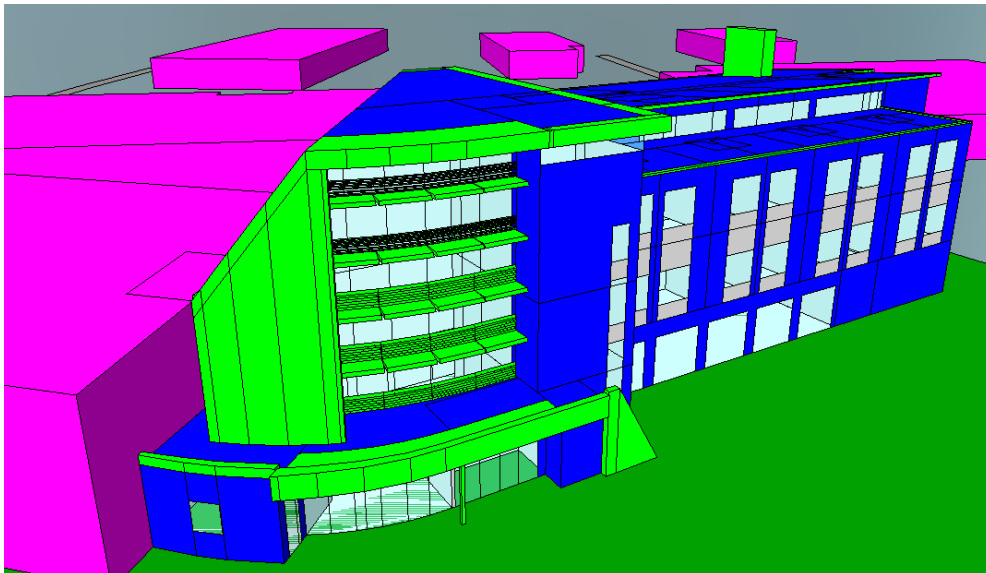


Figure 3 - Model of New Extension to MEU

The model has been produced to carry out thermal modelling for the new extension fit-out and hence determine if improvements to the current design are required to achieve compliance with the aforementioned standards and methodologies.

4.1 Building Fabric

The following are the assumed U-values for the baseline model, and for the current design where U-values have been improved as necessary to reach compliance:

Element	Baseline Building U-value Specification	Proposed Building U-value Specification
Ground Floor	0.12 W/m ² K	0.12 W/m ² K
External Wall	0.18 W/m ² K	0.15 W/m ² K
Flat Roof	0.12 W/m ² K	0.10 W/m ² K
External Windows	1.20 W/m ² K	1.20 W/m ² K

Similarly, the target air permeability for both the original baseline model, and the current building, is shown in the table below:

Element	Baseline Building Air permeability	Proposed Building Air permeability
Air permeability	4.00m ³ /(h·m ²)	3.00m ³ /(h·m ²)

4.2 Weather

The CIBSE Test Reference Year (TRY) dataset was used to demonstrate compliance with the energy regulations (Part L 2021) as well as local planning requirements. The CIBSE Design Summer Year (DSY) dataset was used for the CIBSE TM52 (Overheating Risk) and CIBSE Heating and Cooling Loads studies. The weather datasets have been applied based upon the respective published guidance.

The new extension development is located on Southmoor Road, Manchester, and therefore the Manchester (TRY) and (DSY1) weather files have been utilised. Table 5 below details the specific weather file that has been used for each assessment.

Table 5 - Weather Files Used

Analysis Weather File and Dataset File Name	Analysis Weather File and Dataset File Name	Analysis Weather File and Dataset File Name
Part L 2021 and	Part L 2021 and	Part L 2021 and
Local Planning	Local Planning	Local Planning

4.3 Internal Gains

The internal gains and occupancy levels used for the thermal comfort check were advised by the design team, or otherwise estimated using CIBSE guidance. Internal gains for all assessed room types are tabulated below:

Table 6 Internal Gain Design Criteria

Internal Gain Design Criteria	Internal Gain Design Criteria
Detailed Occupancy	Reception: 9 m ² /person Typical Office: 5 m ² /person Typical Meeting Room = 2.5 m ² /person Typical Lab = 5 m ² /person Ward = 28 people Lighting Reception: 3 W/m ²
Lighting	Reception: 3 W/m ² Typical Office: 4.5 W/m ² Typical Meeting Room = 6.5 W/m ² Typical Lab = 9 W/m ² Ward = 1.5 W/m ²
Equipment	Reception: 5 W/m ² Typical Office: 25 W/m ² Typical Meeting Room = 5 W/m ² Typical Lab = 5 W/m ² Ward = 3 W/m ²

Occupancy heat gains has been applied for all occupied rooms in accordance with table 6.3 of CIBSE Guide A as follows:

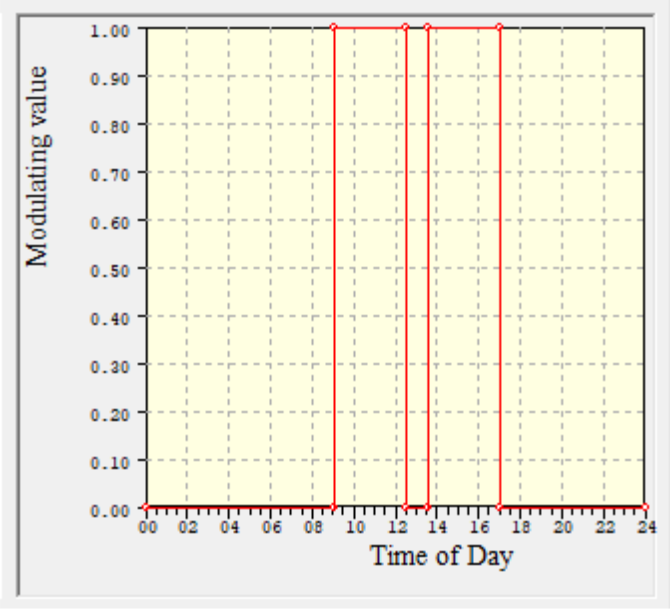
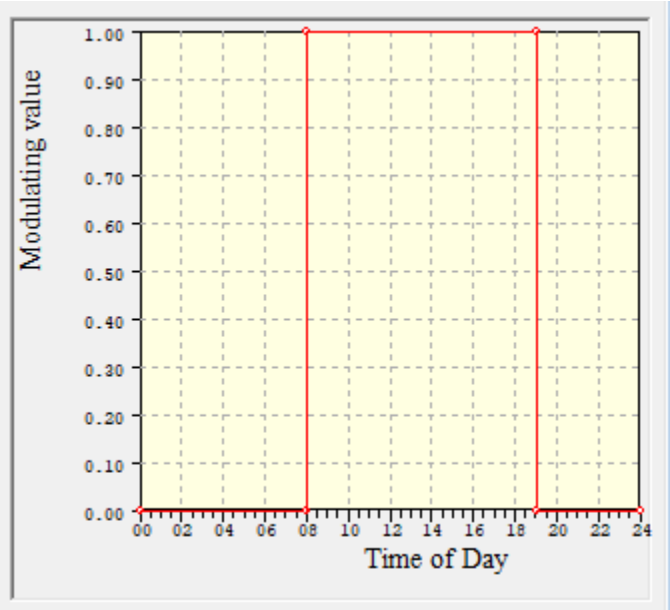
- 90W sensible and 50W latent per person has been applied for all office/meeting, labs, and reception areas.
- 80W sensible and 35W latent per person has been applied for wards, recovery, and bedrooms areas.

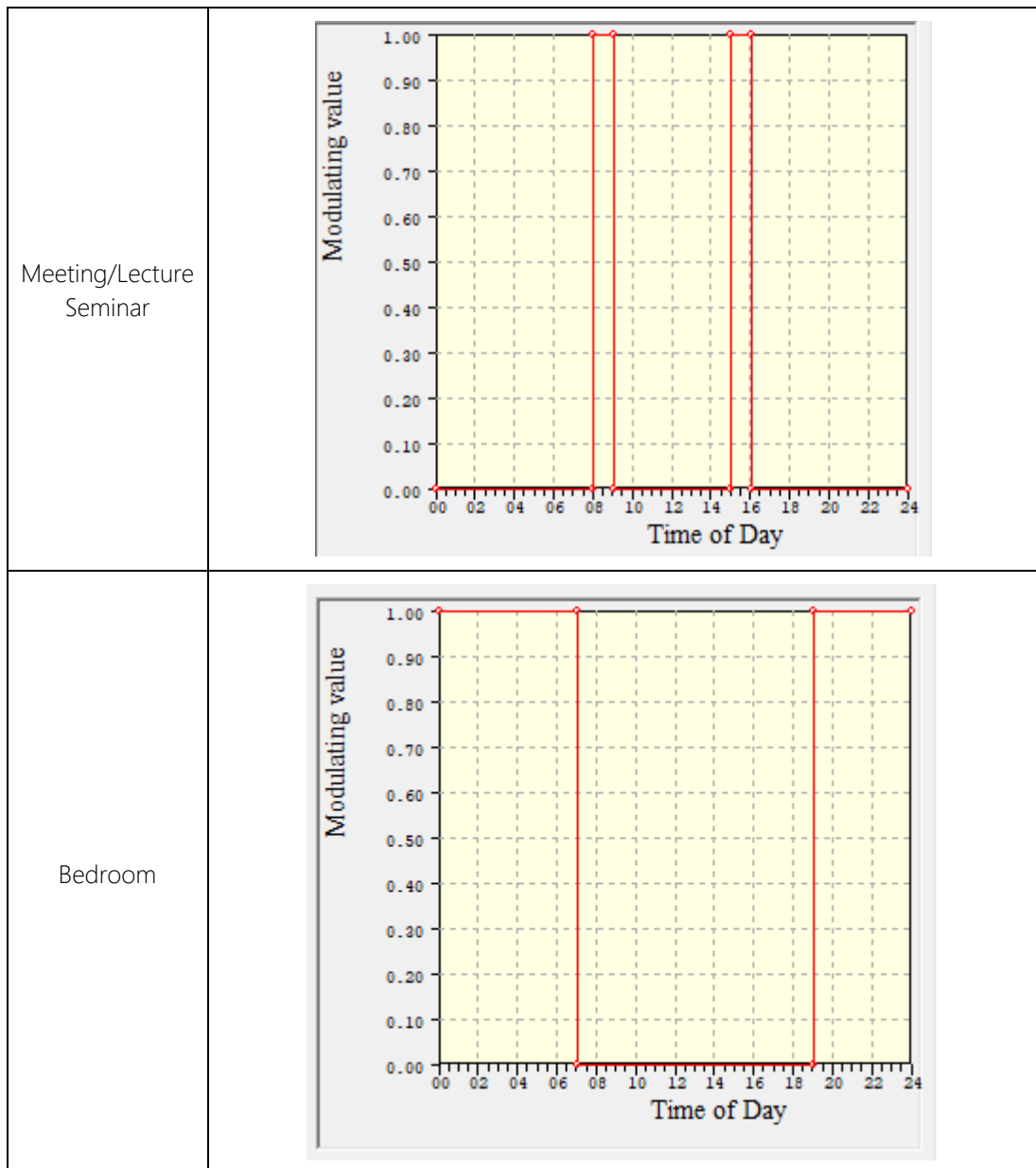
Lighting controls have been modelled as below:

- Presence Detection Control has been modelled in all office areas.
- Manual switching in all other occupied spaces.

Table 7 below shows a summary of the operational profiles applied for each room type. The X-axis dictates the time of operation, and the Y-axis dictates the percentage of operation (0 = no operation, 1.0 = full operation). All room types have been assumed based on their expected usage:

Table 7 - Operational Profiles

Room Type	Operational Profile										
Office/Lab/ C/E	 The graph for Office/Lab/C/E shows a modulating value of 1.00 from 08:00 to 18:00 and 0.00 elsewhere. The y-axis is labeled 'Modulating value' and ranges from 0.00 to 1.00. The x-axis is labeled 'Time of Day' and ranges from 00 to 24. The graph is a step function with a value of 1.00 from 08:00 to 18:00 and 0.00 elsewhere. <table border="1"><thead><tr><th>Time of Day</th><th>Modulating value</th></tr></thead><tbody><tr><td>00</td><td>0.00</td></tr><tr><td>08</td><td>1.00</td></tr><tr><td>18</td><td>0.00</td></tr><tr><td>24</td><td>0.00</td></tr></tbody></table>	Time of Day	Modulating value	00	0.00	08	1.00	18	0.00	24	0.00
Time of Day	Modulating value										
00	0.00										
08	1.00										
18	0.00										
24	0.00										
Lounge	 The graph for Lounge shows a modulating value of 1.00 from 08:00 to 18:00 and 0.00 elsewhere. The y-axis is labeled 'Modulating value' and ranges from 0.00 to 1.00. The x-axis is labeled 'Time of Day' and ranges from 00 to 24. The graph is a step function with a value of 1.00 from 08:00 to 18:00 and 0.00 elsewhere. <table border="1"><thead><tr><th>Time of Day</th><th>Modulating value</th></tr></thead><tbody><tr><td>00</td><td>0.00</td></tr><tr><td>08</td><td>1.00</td></tr><tr><td>18</td><td>0.00</td></tr><tr><td>24</td><td>0.00</td></tr></tbody></table>	Time of Day	Modulating value	00	0.00	08	1.00	18	0.00	24	0.00
Time of Day	Modulating value										
00	0.00										
08	1.00										
18	0.00										
24	0.00										



For lounge area and C/E rooms, diversity factors have been applied to simulate the real-time potential use of these rooms (for example, the volunteer lounge has a total occupancy of 15 people. In real-time operation, the volunteer lounge may not have 15 people throughout the period of the profile shown in Table 9. Therefore, a diversity factor has been applied of 70%, which means that the volunteer lounge will be occupied 70% of its operational time. The office, labs, and C/E rooms will be fully occupied between 9am to 5pm, Monday to Friday, and unoccupied during lunch hour 12 noon to 1pm.

4.4 Ventilation Strategy

Majority of occupied spaces are provided with mechanical ventilation complete with heat recovery. The Aseptic Suite and Laboratories are fed from a dedicated, constant air volume air handling units providing tempered air for heating and

cooling. The other rooms, including but not limited to: meeting rooms, ward, waiting lounges, consult and exam, reception and monitor overnight rooms are fitted with localised mechanical ventilation with heat recovery units (MVHR).

The table below highlights the rooms provided with mechanical ventilation:

Table 8 - Ventilation Flow Rates

Activity Flow Rate (l/s)	Activity Flow Rate (l/s)
HRU 01: Entrance	700
HRU 02&03: Main Ward	738
HRU 04: Toilets, Changing, CT Scanner	631
HRU 05: Main Toilet Block & Lounges	858
HRU 06: Lecture/Seminar	594
HRU 07: Meeting Rooms	660
AHU 01: Labs	587
AHU 02: Aseptic Suit	2370
MVHR: C/E rooms (SBEM)	192
MVHR: Monitor Overnight rooms (SBEM)	192

The air infiltration applied is 0.046 ACH (air changes/hour) Some of the open-plan office areas have a natural ventilation strategy and this has been considered within the overheating assessment.

4.5 Cooling Strategy

Active cooling via a FCU (Fan Coil Unit) system has been allocated to the ward, offices, meeting rooms, volunteer lounge, sample handling lab, and lab write-up as per the current design. The cooling sensible loads were applied from the results of the CIBSE loads assessment, along with their respective cooling set points as advised previously by the client.

The cooling set points for each room type are summarised in Table 9 below. Operational profiles were created where cooling will be applied if the indoor temperature is above the set point during occupied hours.

Table 9 - Cooling Setpoints for Each Room Type

Activity	Cooling Set Point (°C)
Offices	25
Ward	25
Reception	25
Lounges	25
Meeting rooms	25
Lecture / Seminar	25
Open Offices	25
Labs	25
Monitor/Overnight Stay Rooms	25
C/E Rooms	25

5.0 Baseline HVAC services

5.1 Mechanical Services

The mechanical services in the thermal model have been based upon the initial, baseline design conditions. Further improvements were made to the below strategy to achieve compliance with the part L regulations. The improvements were incorporated into the current design proposal.

5.1.1 Heating system

- Constant Volume System (CVS) – Aseptic Suite and Labs.
- Variable Refrigerant Flow (VRF) – Ward & Ward Office, Reception, Lounge's, Meeting rooms, CT Scanner and Control room.
- Fan Coil Unit (FCU) - Lecture/seminar room, Open Offices and 1F North-facing Offices.
- Split System – Comms room.
- Hybrid VRF in C/E rooms and overnight bedrooms

5.1.2 Cooling System

- CVS – Aseptic Suite and Labs.
- VRF – Ward & Ward Office, Reception, Lounge's, Meeting rooms, CT Scanner and Control room.
- FCU - Lecture/seminar room, Open Offices and 1F North-facing Offices.
- Split System – Comms room.

5.1.3 Ventilation System

- AHU – zones served through CVS.
- MVHR – zones served through FCU with a heat recovery of 80%
- Extract ventilation for WC's/Changing areas.
- NV in open offices.

5.1.4 Domestic Hot Water

- 1000L calorifier fed via ASHP (SCOP= 3.87). Storage heat Loss equal to or better than 176W (4.224 kWh/day).

5.2 Electrical Services

The electrical services in the thermal model have been based on the information supplied as follows

- Electric Power Factor for the Whole Building: YES (> 0.95).
- Lighting system has provision for metering: Yes.
- Lighting system metering warns 'out of range' values: No.
- Lighting Energy:
 - 105 lm/cW in all office spaces.
 - 114 lm/cW in all WC's.
 - 123 lm/cW in all circulation spaces.
 - 120 lm/cW in remaining zones (default value for a new LED fitting).
- Lighting Controls:
 - Daylight control for all perimeter office areas.
 - Presence control for all other occupied spaces, circulation and WC's.
 - Manual switching in all plant rooms.

6.0 Energy Compliance

6.1 Energy Demand and Associated Emissions

The energy demand and associated CO₂ emissions have been estimated from the architects initial building layout and through an initial Part L2A compliance calculation. The Part L2A calculation is based upon the initial scheme design and is used as a guideline to assess the percentage of the building's total CO₂ emissions to determine compliance. Improvement measures will be added where required by improving the base design through applying different passive design solutions and LZC technologies. The energy demand figures should be continually reviewed as the design progresses.

The below table quantifies the total energy and CO₂ emissions for building regulated energy as per the Part L2A calculation.

Table 10 - Baseline Results Summary

Description	TER (kgCO ₂ /m ² .yr)	BER (kgCO ₂ /m ² .yr)	TDER (kWh/m ² /yr)	BDER (kWh/m ² /yr)	Compliance Achieved?
Proposed Extension - Baseline	9.26	11.76	99.96	126.68	No

The energy demand figures are used to evaluate the different energy saving strategies and their respective performance parameters, they are not intended to detail operational energy usage for the development, and this would be out with the scope of this study.

From the above results, compliance is not achieved with the current design of the proposed extension. Therefore, improvement measures will need to be implemented in order to comply with the Part L2A 2021 regulations.

6.2 Compliant Improvement Measures and LZCGT Feasibility Study

To ensure that compliance is achieved alongside the above improvements, an LZCGT (Low to Zero Carbon Generating Technologies) feasibility study was undertaken to determine the most appropriate LZCGT for this development. Table 11 below summarizes the possible LZCGT and whether they are feasible for this development or not.

Table 11 - LZC Technologies Feasibility

Technology	Appropriate	Comments
Biomass heating, cooling and electricity	NO	The site lies within a suburban area with little opportunity to build appropriate fuel storage and also there is a lack of local fuel source.
Renewable energy from waste	NO	No capability to generate on-site electricity from waste and may present potential local air quality issues.
Solar Photovoltaics	NO	Not viable in the current scheme due to roof buildup and access limitations
Wind	NO	Building-integrated wind turbines perform poorly due to unfavourable wind microclimate and present a structural issue for the building.
Heat Pumps	YES	Initially proposed for heating and cooling in the base design (base model). Now includes for domestic hot water generation.

Upon reviewing the Part L compliance the following improvements were incorporated to Proposed Design:

1. All panel heaters were removed from design. The C/E and Monitor/overnight stay rooms were fitted with Hybrid VRF system and mechanical ventilation with heat recovery, space conditioning via LTHW FCU's, Heat pump COP = 4.01, EER = 4.36
2. SFP Improvements: AHU = 1.8, MVHR = 1.2.
3. MVHR heat recovery improved to 80%.
4. Target Air permeability improved to 3.0 m³/h.m²
5. Power Factor Correction improved to >0.95
6. Window G-value improved to 0.25 for south-facing occupied spaces (open offices, reception, bedrooms), as well as west-facing Volunteers Lounge.
7. Replaced certain window panes with opaque cladding panels (U-value = 0.15 W/m²K).
8. Roof U-value improvement from 0.12 W/m²K to 0.10 W/m²K.
9. Demand Control Ventilation (DCV) with CO₂ sensors with speed control, applied to all rooms served by AHU and MVHR.

10. Replace all Point of Use DHW systems with 1000L calorifier fed via ASHP (SCOP= 3.87). Storage heat Loss equal to or better than 176W (4.224 kWh/day).
11. Where default lighting was modelled previously (100lm/cW), these were improved to 120lm/cW.
12. Lighting Controls:
 - a) Meeting Rooms have Absence Detection.
 - b) Stores, Comms Room and Quiet Rooms have Presence Detection.

Table 12 below outlines the results achieved with the proposed improvement strategy.

Table 12 – Proposed Design improved Strategy Results Summary

Description	TER (kgCO ₂ /m ² .yr)	BER (kgCO ₂ /m ² .yr)	TDER (kWh/m ² /yr)	BDER (kWh/m ² /yr)	Compliance Achieved?
Proposed Extension - Improvement Strategy	7.61	7.47	82.96	81.54	YES

The development now complies with Part L2A of the building incorporating the aforementioned improvements.

It is anticipated that further energy assessments may be completed as the design progresses, thus these results are subject to change.

6.3 Solar Gain Check (Criterion 3)

Criterion 3 of Part L2A requires that the passive design of the building should be able to limit solar gain in the Summer. If there is too much solar gain into a space, there is a risk of overheating and therefore the cooling system (if one serves the affected space) would need to be used more often, impacting the energy consumption of the building.

Table 13 below shows the rooms that failed this Criterion 3 check for the base design.

Table 13 - Solar Gain Exceedance (Base Design)

Room	% of Solar Gain Exceedance
L00: Open Office 01	69.4%
L00: Reception	219.8%
L00: Volunteer Lounge	48.7%
L02: Bedroom 01	4.8%
L02: Bedroom 02	18.8%
L02: Bedroom 03	25.1%
L02: Bedroom 04	25.6%
L02: Bedroom 05	25.8%
L02: Bedroom 06	25.8%
L02: Bedroom 07	23.4%

From the above table, the rooms that are of concern are the South-facing 'Reception' and 'Open Office 01' on the Ground Floor, as well as the Volunteer Lounge facing West. The bedrooms are not expected to be used as often as a typical residential bedroom, however the solar gain within these spaces should be reduced to improve thermal comfort.

The following improvement measures were implemented to reduce solar gain:

1. Window G-value improved to 0.25 for south-facing occupied spaces (open offices, reception, bedrooms), as well as west-facing Volunteers Lounge (same as point 3 in Section 4.2). Atrium glazing G-value was also improved to 0.24.
2. Reception area glazing has been shaded by moving the front façade glazing inwards to create a 1.5m overhang (in-line with discussions with the architect).
3. Atrium shading elements were revised, and the following shading elements were incorporated according to the architect's proposal:
 - a) 1000mm horizontal louvres at every transom level
 - b) A 600mm band of vertical louvres above every transom level
 - c) A 900mm band of vertical louvres to the entrance area

Figure 4 shows the updated model, that incorporates the design changes described in points 2 and 3 above:

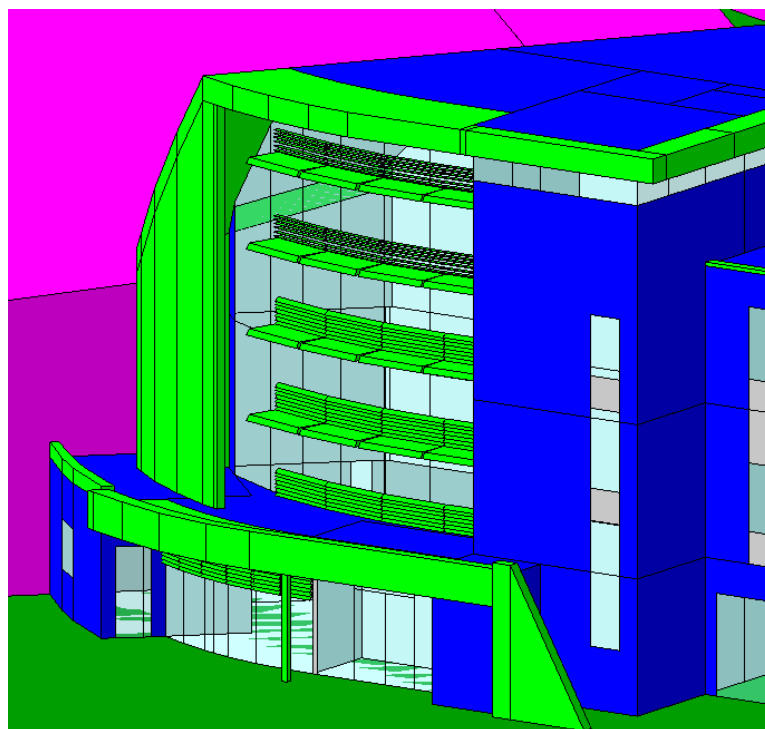


Figure 4 – Additional shading elements to atrium façade

With this new proposed design, there is now zero rooms failing criterion 3, including the reception area which now has no solar gain exceedance as shown in the table below:

Table 14 - Solar Gain Exceedance (Improvement Measures – Updated Design)

Room	% of Solar Gain Exceedance
L00: Reception	-11.9%

7.0 Thermal Comfort Analysis

A thermal comfort analysis has been carried out in accordance with the CIBSE TM52 guideline. The thermal modelling has been carried out using the dynamic simulation tool, Virtual Environment 2023 and applied in accordance with CIBSE AM11 "Building Energy and Environmental Modelling".

The calculation was carried out for all occupied rooms – considering internal gains, ventilation strategy and openable windows/doors.

For this assessment, all occupied areas have been assessed with respect to the TM52 guidance.

The CIBSE TM52 guidance document shows different categories that represents different expectations of overheating, depending on the building type. Figure 5 below shows the table that describes these categories and their respective temperature ranges of overheating:

Table 2 Suggested applicability of the categories and their associated acceptable temperature range for free-running buildings and of PMV for mechanically ventilated buildings (from BSI, 2007). The CIBSE suggestion is that designers should aim to remain within the Category II limits.			
Category	Explanation	Suggested acceptable range (K)	Suggested acceptable limits PMV
I	High level of expectation only used for spaces occupied by very sensitive and fragile persons	± 2	± 0.2
II	Normal expectation (for new buildings and renovations)	± 3	± 0.5
III	A moderate expectation (used for existing buildings)	± 4	± 0.7
IV	Values outside the criteria for the above categories (only acceptable for a limited periods)	>4	> 0.7

Figure 5 - Categories of Expectation of Overheating (CIBSE 2015)

As this is a new building, Category II was chosen for this assessment.

Section's 6.2 to 6.5 will show the results of the base case and any improvement measures that were taken to achieve full compliance with the CIBSE overheating methodologies. A summary table of results will be shown for each iteration that shows a count of how many rooms passed or fail the TM52 standard, and a second table that will show detailed results for the rooms which fail compliance. Appendices have been included that shows the full set of results for each iteration.

7.1 Overview of TM52 Methodology

In general, three parameters have been developed which indicate when overheating is likely to be problematic. These standards generally apply outside the heating season and are for the occupied period from 1st May to 30th September.

1. The number of hours for which a threshold temperature is exceeded.
2. The degree to which the internal temperature exceeds the external temperature.
3. The maximum temperature experienced at any occupied time.

The performance criteria for summertime overheating in compliance with CIBSE TM52 – Adaptive Thermal Comfort are as follows:

4. The hours of exceedance (%He) during which ΔT exceeds 1°C shall not exceed 3% of occupied hours.
5. The daily weighted exceedance (We) shall be less than 6 hours per day for any one day.
6. The upper temperature limit (T_{upp}) states that ΔT shall not exceed 4°C at any one time.

The analysis is to be conducted for a minimum period of 1st of May to the 30th of September, and using the most appropriate CIBSE DSY weather file, as specified in Section 3.2.

Two criteria must be met to demonstrate compliance for that design option. The operative temperature has been assessed with respect to the TM52 standard. The operative temperature is defined as the combined effect of the room air temperature and mean radiant temperature: the equivalent 'dry resultant temperature' within the IES model is reported for this analysis.

7.2 Result Analysis – Base Case

The following results reflects the current design stage layouts and ventilation strategy for the building. The initial results demonstrates the overheating risk, as shown in the summarised results in Table 15 below:

Table 15 - Base Case Results Summary

TM52 Compliance Count	Pass	30
	Fail	16

Table 16 below shows the worst-case results of the baseline for TM52 assessment. All the areas that have mechanical ventilation and active cooling have passed compliance from the TM52 calculation.

Table 16 - Base Case (Worst-Performing Rooms)

TM52 RESULTS		NOTE: If any two criteria fail, the room fails to comply		
Room Name	TM52 Criterion 1 DT > 1 K for ≤ 3 % of occupied hours May- Sep	TM52 Criterion 2 Max. Daily Deg. Hrs ≤ 6	TM52 Criterion 3 Max. DeltaT ≤ 4	TM52 Compliant?
	% of hours	No. of hours	DeltaT	
L01: C/E 01	26	40	6	Fail
L01: C/E 02	31.2	46	7	Fail
L01: C/E 03	33.9	46	7	Fail
L01: C/E 04	36.9	47	7	Fail
L01: C/E 05	37.4	47	7	Fail
L01: C/E 06	36.7	47	7	Fail
L01: C/E 07	33.5	44	7	Fail
L01: C/E 08	24.8	36	5	Fail
L02: Bedroom 01	4.6	14	3	Fail
L02: Bedroom 02	10.4	27	4	Fail
L02: Bedroom 03	11.9	30	4	Fail
L02: Bedroom 04	12.3	32	5	Fail
L02: Bedroom 05	12.3	32	5	Fail
L02: Bedroom 06	12.1	30	4	Fail
L02: Bedroom 07	11.4	29	4	Fail
L02: Bedroom 08	9.4	25	4	Fail

The results reflect a significant overheating risk for all bedrooms and C/E rooms, all located within the south-facing portion of the building. It was determined that the lack of ventilation and active cooling results in higher overheating risk for the

base case scenario. As these are predominantly south-facing rooms, this results in higher solar gains entering each room and there is little shading being provided from adjacent buildings, thus increasing overheating risk

From the above results, it is conclusive that the base design does not present a desirable solution, and investigation of further mitigation options is required to ensure the overheating risk is minimised. The proposed mitigation strategies have only been applied to the south-facing rooms, across all floors.

7.3 Result Analysis - Mitigation (inclusion of Hybrid VRF)

The proposed mitigation strategy is to add Hybrid VRF to the bedrooms and C/E rooms, applied across floors 2 and 3.

The summary of results for the mitigation strategy are shown in the table below:

Table 17 - Mitigation 1 Results Summary

TM52 Compliance Count	Pass	46
	Fail	0

Adding Hybrid VRF to all bedrooms and C/E rooms has resulted in all previously failing rooms now passing the overheating criteria, as seen in the table below:

Table 18 - Mitigation 1 (Worst-Performing Rooms)

TM52 RESULTS		NOTE: If any two criteria fail, the room fails to comply		
Room Name	TM52 Criterion 1 DT > 1 K for ≤ 3 % of occupied hours May- Sep	TM52 Criterion 2 Max. Daily Deg. Hrs ≤ 6	TM52 Criterion 3 Max. DeltaT ≤ 4	TM52 Compliant?
	% of hours	No. of hours	DeltaT	
L01: C/E 01	0	0	0	Pass
L01: C/E 02	0	0	0	Pass
L01: C/E 03	0	0	0	Pass
L01: C/E 04	0	0	0	Pass

L01: C/E 05	0	0	0	Pass
L01: C/E 06	0	0	0	Pass
L01: C/E 07	0	0	0	Pass
L01: C/E 08	0	0	0	Pass
L02: Bedroom 01	0	0	0	Pass
L02: Bedroom 02	0	0	0	Pass
L02: Bedroom 03	0	0	0	Pass
L02: Bedroom 04	0	0	0	Pass
L02: Bedroom 05	0	0	0	Pass
L02: Bedroom 06	0	0	0	Pass
L02: Bedroom 07	0	0	0	Pass
L02: Bedroom 08	0	0	0	Pass

From the above tables, all the C/E rooms are compliant with the CIBSE TM52 standards, meaning that all occupied rooms now demonstrate low overheating risk upon implementing the mitigation.

8.0 Conclusion

The thermal modelling for thermal performance analysis and energy compliance checks have been conducted to identify the most viable design options.

The thermal modelling has been conducted to meet energy compliance requirements as per the Part L2A English Energy Regulations and to determine whether the proposed services strategy provides for low overheating risk for the proposed extension through the CIBSE TM52 methodology.

The results obtained through the above analysis process allowed to develop a cost-efficient design proposal which meets the requirements of Part L2A regulations fully.

In contrast with the initial design concept (regarded as base design), those improvements covered increased MEP services efficiency including, but not limited to:

- i. providing complete heating, potable hot water and cooling services from high-efficiency air source heat pump system
- ii. increasing efficiency of localised mechanical heat recovery ventilation controlled on demand basis (via CO₂ sensors) and complete with accurate speed control
- iii. inclusion of hybrid variable refrigerant system (HVRF) providing heating and cooling to the rooms located on south façade mitigating overheating risks and meeting TM52 compliance fully
- iv. Improvements to minimum lighting average luminaire efficacy from 100 to 120 Lm/cW (luminaire lumens per circuit watt)
- v. Improved lighting control philosophy.

In addition to MEP strategy and to fully meet the compliance with Part L2A regulations, further improvements were proposed. Those included:

- i. Improving the building fabric
- ii. Installation of the shading elements to the reception area and atrium to mitigate high solar gain.

Appendix 1 – Base Case TM52 Result

TM52 RESULTS		NOTE: If any two criteria fail, the room fails to comply		
Room Name	TM52 Criterion 1 DT > 1 K for ≤ 3 % of occupied hours May- Sep	TM52 Criterion 2 Max. Daily Deg. Hrs ≤ 6	TM52 Criterion 3 Max. DeltaT ≤ 4	TM52 Compliant?
	% of hours	No. of hours	DeltaT	
L00: Ward Office	0	0	0	Pass
L00: Open Office 01	0	0	0	Pass
L00: Office 02	0.7	3	1	Pass
L00: Quite Room	0	0	0	Pass
L00: Reception	0	0	0	Pass
L00: Recovery	0	0	0	Pass
L00: Volunteer Lounge	0	0	0	Pass
L00: Ward	0	0	0	Pass
L01: Biomarker Lab	0	0	0	Pass
L01: C/E 01	25	40	6	Fail
L01: C/E 02	31.2	46	7	Fail
L01: C/E 03	33.9	46	7	Fail
L01: C/E 04	36.9	47	7	Fail
L01: C/E 05	37.4	47	7	Fail
L01: C/E 06	36.7	47	7	Fail
L01: C/E 07	33.5	44	7	Fail
L01: C/E 08	24.8	36	5	Fail
L01: Grd B	0.7	4	2	Pass

Medicines Evaluation Unit
Environmental Standards Statement

L01: Grd C 01	0.2	2	1	Pass
L01: Grd C 02	0.3	2	1	Pass
L01: Grd D	0.5	2	1	Pass
L01: Lab Write Up Office	0	0	0	Pass
L01: Office	0	0	0	Pass
L01: Open Plan Office 01	0	0	0	Pass
L01: Open Plan Office 02	0	0	0	Pass
L01: sample Handling Lab	0	0	0	Pass
L01: Set Up 01	0.1	1	1	Pass
L01: Set Up 02	0.1	1	1	Pass
L01: Support Room (Grd B)	0.3	2	1	Pass
L01: Support Room (Grd C)	0.3	2	1	Pass
L01: Wait Lounge	0	0	0	Pass
L02: Bedroom 01	4.6	14	3	Fail
L02: Bedroom 02	10.4	27	4	Fail
L02: Bedroom 03	11.9	30	4	Fail
L02: Bedroom 04	12.3	32	5	Fail
L02: Bedroom 05	12.3	32	5	Fail
L02: Bedroom 06	12.1	30	4	Fail
L02: Bedroom 07	11.4	29	4	Fail
L02: Bedroom 08	9.4	25	4	Fail
L02: Lecture/Seminar	0	0	0	Pass

Medicines Evaluation Unit
Environmental Standards Statement

L02: Lounge	0	0	0	Pass
L02: Meeting Room 01	0	0	0	Pass
L02: Meeting Room 02	0	0	0	Pass
L02: Meeting Room 03	0	0	0	Pass
L02: Meeting Room 04	0	0	0	Pass
L02: Office Open	0	0	0	Pass

Appendix 2 – Mitigation 1 TM52 Results

TM52 RESULTS		NOTE: If any two criteria fail, the room fails to comply		
Room Name	TM52 Criterion 1 DT > 1 K for ≤ 3 % of occupied hours May- Sep	TM52 Criterion 2 Max. Daily Deg. Hrs ≤ 6	TM52 Criterion 3 Max. DeltaT ≤ 4	TM52 Compliant?
	% of hours	No. of hours	DeltaT	
L00: Ward Office	0	0	0	Pass
L00: Open Office 01	0	0	0	Pass
L00: Office 02	0.7	3	1	Pass
L00: Quite Room	0	0	0	Pass
L00: Reception	0	0	0	Pass
L00: Recovery	0	0	0	Pass
L00: Volunteer Lounge	0	0	0	Pass
L00: Ward	0	0	0	Pass
L01: Biomarker Lab	0	0	0	Pass
L01: C/E 01	0	0	0	Pass
L01: C/E 02	0	0	0	Pass
L01: C/E 03	0	0	0	Pass
L01: C/E 04	0	0	0	Pass
L01: C/E 05	0	0	0	Pass
L01: C/E 06	0	0	0	Pass
L01: C/E 07	0	0	0	Pass
L01: C/E 08	0	0	0	Pass

L01: Grd B	0.7	4	2	Pass
L01: Grd C 01	0.1	1	1	Pass
L01: Grd C 02	0.3	2	1	Pass
L01: Grd D	0.3	2	1	Pass
L01: Lab Write Up Office	0	0	0	Pass
L01: Office	0	0	0	Pass
L01: Open Plan Office 01	0	0	0	Pass
L01: Open Plan Office 02	0	0	0	Pass
L01: Sample Handling Lab	0	0	0	Pass
L01: Set Up 01	0.1	1	1	Pass
L01: Set Up 02	0.1	1	1	Pass
L01: Support Room (Grd B)	0.3	2	1	Pass
L01: Support Room (Grd C)	0.3	2	1	Pass
L01: Wait Lounge	0	0	0	Pass
L02: Bedroom 01	0	0	0	Pass
L02: Bedroom 02	0	0	0	Pass
L02: Bedroom 03	0	0	0	Pass
L02: Bedroom 04	0	0	0	Pass
L02: Bedroom 05	0	0	0	Pass
L02: Bedroom 06	0	0	0	Pass
L02: Bedroom 07	0	0	0	Pass
L02: Bedroom 08	2.9	0	0	Pass
L02: Lecture/Seminar	0	0	0	Pass
L02: Lounge	0	0	0	Pass

Medicines Evaluation Unit
Environmental Standards Statement

L02: Meeting Room 01	0	0	0	Pass
L02: Meeting Room 02	0	0	0	Pass
L02: Meeting Room 03	0	0	0	Pass
L02: Meeting Room 04	0	0	0	Pass
L02: Office Open	0	0	0	Pass