Anglia Square, Norwich
Daylight and Sunlight Report
Internal Daylight, Sunlight & Overshadowing Report

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Dated July 2022

Weston Homes

CHARTERED SURVEYORS

THE DAYLIGHT DEPARTMENT

REVISED INTERNAL DAYLIGHT, SUNLIGHT AND OVERSHADOWING REPORT

Anglia Square, Norwich

19 July 2022

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CONTENTS

1 EXECUTIVE SUMMARY

The purpose of this report is to ascertain whether the proposed development will provide residential accommodation considered acceptable in terms of daylight and sunlight.

In order to gauge the overall performance of the scheme, a selection of units within the lowest residential storeys of the detailed plots have been technically assessed as a worst-case scenario. The daylight and sunlight availability will increase on the upper floors, where the sky visibility is greater.

The results show that 67% of the tested rooms will meet or exceed the levels of Average Daylight Factor recommended by BRE. Should all habitable rooms within the scheme be assessed, the level of compliance would increase further.

Good levels of sunlight are seen on most facades with a southerly aspect. Levels of sunlight lower than those suggested can be seen in some areas, particularly on the lowest storeys and below balconies as is to be expected in a scheme of this nature and size.

For the outline plots, daylight and sunlight potential assessments have been undertaken on the facades and these show that these plots have the potential to offer good daylight and sunlight amenity for the enjoyment of future occupants. Detailed assessments will be provided at detailed design stage.

Finally, a number of open spaces, both public and communal, are provided across the scheme and perform very well in terms of sunlight availability, overall.

Further details are provided in Section 5 and the full assessment results are provided in Sections 7, 8 and 9.

2 INTRODUCTION

GIA has been instructed to provide a report upon the potential availability of Daylight and Sunlight to the proposed accommodation within the residential scheme prepared by Broadway Malyan. GIA was specifically instructed to carry out the following:

- To create a 3D computer model of the proposal based upon drawings prepared by Broadway Malyan.
- Carry out a daylight assessment for the blocks proposed in detail using the methodologies set out in the BRE guidance for Average Daylight Factor, No-Sky Line and Room Depth Criterion.
- Carry out a daylight potential assessment for the blocks proposed in outline using the Vertical Sky Component (VSC) as defined within the BRE guidance.
- Carry out a sunlight assessment using the methodologies set out in the BRE guidance for Annual Probable Sunlight Hours (APSH) to the fenestration facing within 90° of due south.
- Carry out an overshadowing assessment using the methodology set out in the BRE guidance for Sun Hours On Ground (SHOG) for all relevant amenity areas.
- Prepare a report setting out the analysis and our findings.

3 BRE GUIDELINES

The Building Research Establishment (BRE) have set out in their handbook 'Site Layout Planning for Daylight and Sunlight a Guide to Good Practice (2011)', guidelines and methodology for the measurement and assessment of daylight and sunlight within proposed buildings.

This document states that it is intended to be used in conjunction with the daylight recommendations found within the British Standard BS8206-2:2008 and The Applications Manual on Window Design of the Chartered Institution of Building Services Engineers (CIBSE. 1999).

The guide also provides advice on site layout planning to determine the quality of daylight and sunlight within open spaces between buildings.

It is important to note, however, that this document is a guide and states that its aim *"is to help rather than constrain the designer"*.

The document provides advice, but also clearly states that it *"is not mandatory and this document should not be seen as an instrument of planning policy."* The report also acknowledges in its introduction that *"in special circumstances the developer or planning authority may wish to use different target values. For example, in a historic city centre a higher degree of obstruction may be unavoidable if new developments are to match the height and proportions of existing buildings."*

It is an inevitable consequence of the built-up urban environment that daylight and sunlight will be more limited in these areas. It is well acknowledged that in such situations there may be many other conflicting and potentially more important planning and urban design matters to consider other than just the provision of ideal levels of daylight and sunlight.

The 2011 version of the BRE guidelines have been used throughout the design process of the Proposed Development.

In June 2022 an new version of the Guidelines was published, which changes the criteria and methodology to assess daylight and sunlight within newly proposed schemes. However, the aim of the new guidance is the same as the old one, which is "to help ensure good conditions in the local environment considered broadly, with enough sunlight and daylight on or between the buildings for good interior and exterior conditions", as stated in Paragraph 1.5 of the new guidance.

Given the above, it is considered appropriate to provide the numerical results of the assessment s for the Proposed Scheme based on the 2011 BRE guidance. The conclusions presented within this report are not considered to be substantially different should the assessments be carried out according to the 2022 BRE guidance.

2.1 DAYLIGHT

The BRE set out various methods for assessing the daylight within a proposed building within section 2.1 and Appendix C of the handbook. These are summarised below.

Vertical Sky Component (VSC)

This method of assessment can be undertaken using a skylight indicator or a Waldram diagram. It measures from a single point, at the centre of the window (if known at the early design stage), the quantum of sky visible taking into account all external obstructions. Whilst these obstructions can be either other buildings or the general landscape, trees are usually ignored unless they form a continuous or dense belt of obstruction.

The VSC method is a useful 'rule of thumb' but has some significant limitations in determining the true quality of daylight within a proposed building. It does not take into account the size of the window, any reflected light off external obstructions, any reflected light within the room, or the use to which that room is put. Appendix C of the guide goes into more detail on these matters and sets forward alternative methods for assessment to overcome these limitations.

Appendix C of the BRE guide: Interior Daylighting Recommendations, states:

"The British Standard Code of practice for daylighting (BS 8206-2) and the CIBSE Lighting Guide LG 10 Daylighting and window design contain advice and guidance on interior daylighting. The guidance contained in this publication (BR 209) is intended to be used with BS 8206-2 and LG 10. Both these publications refer to BR 209.

For skylight BS 8206-2 and LG 10 put forward three main criteria, based on average daylight factor (ADF); room depth; and the position of the no sky line."

These assessments are set out below.

Average Daylight Factor (ADF)

"If a predominantly daylit appearance is required, then the ADF should be 5% or more if there is no supplementary electric lighting, or 2% or more if supplementary electric lighting is provided. There are additional recommendations for dwellings of 2% for kitchens, 1.5% for living rooms and 1% for bedrooms. These additional recommendations are minimum values of ADF which should be attained even if a predominantly daylit appearance is not achievable."

This method of assessment takes into account the total glazed area to the room, the transmittance quality of the glazing proposed, the total area of the room surfaces including ceilings and floors, and the internal average reflectance for the room being assessed. The method also takes into account the Vertical Sky Component and the quantum of reflected light off external surfaces.

This is, therefore, a significantly more detailed method of assessment than the Vertical Sky Component method set out above.

Room Depth Criterion (RDC)

Where it has access to daylight from windows in one wall only, the depth of a room can become a factor in determining the quantity of light within it. The BRE guidance provides a simple method for examining the ratio of room depth to window area. However, whilst it does take into account internal surface reflections, this method also has significant limitations in that it does not take into account any obstructions outside the window and therefore draws no input from the quantity of light entering the room.

No Sky Line (NSL)

This third method of assessment is a simple test to establish where within the proposed room the sky will be visible through the windows, taking into account external obstructions. The assessment is undertaken at working plane height (850mm above floor level) and the method of calculation is set out in Appendix D of the BRE handbook.

Appendix C of the BRE handbook states *"If a significant area of the working plane (normally more than 20%) lies beyond the no sky line (ie it receives no direct skylight) then the distribution of daylight in* *the room will look poor and supplementary electric lighting will be required."* To guarantee a satisfactory daylight uniformity, the area which does not receive direct skylight should not exceed 20% of the floor area, as quantified in the BS 8206 Part 2 2008.

Summary

The Average Daylight Factor gives a more detailed assessment of the daylight within a room and takes into account the highest number of factors in establishing a quantitative output.

However, the conclusion of Appendix C of the BRE guide states:

"[All three of] the criteria need to be satisfied if the whole of the room is to look adequately daylit. Even if the amount of daylight in a room (given by the Average Daylight Factor) is sufficient, the overall daylight appearance will be impaired if its distribution is poor."

In most urban areas it is important to recognise that the distribution of daylight within a room may be difficult to achieve, given the built-up nature of the environment. Consequently, most local authorities seek to ensure that there is sufficient daylight within the room as determined by the Average Daylight Factor calculation. However, the additional recommendations of the BRE and British Standard for residential accommodation, set out above, ought not to be overlooked.

2.2 SUNLIGHT

The BRE provide guidance in respect of sunlight quality for new developments within section 3.1 of the handbook. It is generally acknowledged that the presence of sunlight is more significant in residential accommodation than it is in commercial properties, and this is reflected in the BRE document.

It states, *"in housing, the main requirement for sunlight is in living rooms, where it is valued at any time of the day, but especially in the afternoon. Sunlight is also required in conservatories. It is viewed as less important in bedrooms and in kitchens where people prefer it in the morning rather than the afternoon."*

The BRE guide considers the critical aspects of orientation and overshadowing in determining the availability of sunlight at a proposed development site.

The guide proposes minimizing the number of dwellings whose living room face solely north unless there is some compensating factor such as an appealing view to the north, and it suggests a number of techniques to do so. Furthermore, it discusses massing solutions with a sensitive approach to overshadowing, so as to maximize access to sunlight.

At the same time, it acknowledges that the site's existing urban environment may impose orientation or overshadowing constraints which may not be possible to overcome.

To quantify sunlight access for interiors where sunlight is expected, it refers to the BS 82606-2 criterion of Annual Probable Sunlight Hours. APSH is defined as *"the total number of hours in the year that the sun is expected to shine on unobstructed ground, allowing for average levels of cloudiness at the location in question."* In line with the recommendation, APSH is measured from a point on the inside face of the window, should the locations have been decided. If these are unknown, sunlight availability is checked at points 1.6m above the ground or the lowest storey level on each main window wall, and no more than 5m apart. If a room has multiple windows on the same wall or on adjacent walls, the highest value of APSH should be taken into account. If a room has two windows on opposite walls, the APSH for each can be added together.

The summary of section 3.1 of the guide states as follows:

"In general, a dwelling or non-domestic building which has a particular requirement for sunlight, will appear reasonably sunlit provided that:

- *At least one main window faces within 90 degrees of due south, and*
- *The centre of at least one window to a main living room can receive 25% of annual probable sunlight hours, including at least 5% of annual probable sunlight hours in the winter months between 21 September and 21 March. "*

In paragraph 3.1.11 the BRE guidance suggests that if a room faces significantly North of due East or West it is unlikely to meet the recommended levels proposed by the BS 8206-2. As such, it is clear that only windows facing within 90 degrees of due South can be assessed using this methodology.

It is also worth noting how paragraph 5.3 of the BS 8206-2 suggests that with regards to sunlight duration *"the degree of satisfaction is related to the expectation of sunlight. If a room is necessarily north facing or if the building is in a densely-built urban area, the absence of sunlight is more acceptable than when its exclusion seems arbitrary"*.

2.3 OVERSHADOWING

The BRE guidance in respect of overshadowing of amenity spaces is set out in section 3.3 of the handbook. Here it states as follows:

"Sunlight in the spaces between buildings has an important impact on the overall appearance and ambiance of a development. It is valuable for a number of reasons, to:

- *provide attractive sunlit views (all year)*
- *make outdoor activities, like sitting out and children's play more pleasant (mainly warmer months)*
- *encourage plant growth (mainly spring and summer)*
- *dry out the ground, reducing moss and slime (mainly in colder months)*
- *melt frost, ice and snow (in winter)*
- *dry clothes (all year)"*

Again, it must be acknowledged that in urban areas the availability of sunlight on the ground is a factor which is significantly controlled by the existing urban fabric around the site in question and so may have very little to do with the form of the development itself. Likewise, there may be many other urban design, planning and site constraints which determine and run contrary to the best form, siting and location of a proposed development in terms of availability of sun on the ground.

The summary of section 3.3 of the guide states as follows:

"3. 3 .17 It is recommended that for it to appear adequately sunlit throughout the year, at least half of a garden or amenity area should receive at least two hours of sunlight on 21 March. If as a result of new development an existing garden or amenity area does not meet the above, and the area which can receive two hours of sun on 21 March is less than 0.8 times its former value, then the loss of sunlight is likely to be noticeable. If a detailed calculation cannot be carried out, it is recommended that the centre of the area should receive at least two hours of sunlight on 21 March."

2.4 FURTHER RELEVANT INFORMATION

Further information can be found in The Daylight in Urban Areas Design Guide (Energy Saving Trust CE257, 2007) which provides the following recommendation with regards to VSC levels in urban areas:

"If 'theta' (Visible sky angle) is greater than 65° (obstruction angle less than 25° or VSC at least 27 percent) conventional window design will usually give reasonable results.

If 'theta' is between 45° and 65° (obstruction angle between 25° and 45°, VSC between 15 and 27 percent), special measures such as larger windows and changes to room layout are usually needed to provide adequate daylight.

If 'theta' is between 25° and 45° (obstruction angle between 45° and 65°, VSC from 5 to 15 percent), it is very difficult to provide adequate daylight unless very large windows are used.

If 'theta' is less than 25° (obstruction angle more than 65°, VSC less than 5 percent) it is often impossible to achieve reasonable daylight, even if the whole window wall is glazed."

4 METHODOLOGY

In order to undertake the daylight and sunlight assessments set out in the previous pages, we have prepared a three dimensional computer model and used specialist lighting simulation software.

The three dimensional representation of the proposed development has been modelled using the scheme drawings provided to us by Broadway Malyan. This has been placed in the context of its surrounding buildings which have been modelled from photogrammetry and OS. This allows for a precise model, which in turn ensures that analysis accurately represents the amount of daylight and sunlight available to the building facades, internal and external spaces, considering all of the surrounding obstructions and orientation.

4.1 SIMULATION ASSUMPTIONS

Where no values for reflectance, transmittance and maintenance factor were specified by the designer the following values from *BS 8206-2:2008, Annex A, tables A.1-A.6* were used for the calculation of Average Daylight Factor values. These values are shown in Table 1.

As is common in many new residential developments, kitchens are often located in the rear part of combined living/kitchen/dining rooms or kitchen/dining rooms. Being in the area of the room farthest away from the window, they typically receive lower levels of daylight than the rest of the room and will often require supplementary artificial lighting.

Where this is the case, and an area devoted to the kitchen function can be identified that is hierarchically separated from dining and living areas, this has been omitted from the calculations, and just the main habitable living area within the room has been assessed. This is reflected in the room labelling.

A light finish has been assumed for the floors.

Table 01: Typical reflectance, transmittance and maintenance factors

REFLECTANCE VALUES:	
Surrounding	0.2
Pavement	0.2
Grass	0.1
Water	0.1
Yellow brick	0.3
Red brick	0.2
Portland Stone	0.6
Concrete	0.4
Internal walls (light grey)	0.68
Internal ceiling (white paint)	0.85
Internal floor (medium veneer)	0.3
Internal floor (light veneer)	0.4

TRANSMITTANCE VALUES	TV
Triple glazing (Low-E): Pilkington K Glass 4/12/4/12/4 Argon filled 90%	0.63
Double glazing (Low-E): Pilkington K Glass 4/16/4 Argon filled 90%	0.75
Single glazing: Pilkington Optifloat Clear 4mm Annealed	0.90
Translucent glazing (Low-E): Pilkington Optifloat Opal - 4mm K /16/4mm Opal	0.74

MAINTENANCE FACTORS: GLAZING TYPE	TV (Normal)	A.3	A.4	A.5	A.6	TV (Total)
Triple Low-E (frames modelled)	0.63	8	1	1	1	0.58
Triple Low-E (frames not modelled)	0.63	8	1	1	0.8	0.46
Triple Low-E (inclined, frames modelled)	0.63	8	2	1	1	0.53
Triple Low-E (inclined, frames not modelled)	0.63	8	2	1	0.8	0.42
Triple Low-E (horizontal, frames modelled)	0.63	8	3	1	1	0.48
Triple Low-E (horizontal, frames not modelled)	0.63	8	3	1	0.8	0.38
Double Low-E (frames modelled)	0.75	8	1	1	1	0.69
Double Low-E (frames not modelled)	0.75	8	1	1	0.8	0.55
Double Low-E (inclined, frames modelled)	0.75	8	2	1	1	0.63
Double Low-E (inclined, frames not modelled)	0.75	8	2	1	0.8	0.50
Double Low-E (horizontal, frames modelled)	0.75	8	3	1	1	0.57
Double Low-E (horizontal, frames not modelled)	0.75	8	3	1	0.8	0.46
Single (frames modelled)	0.9	8	1	1	1	0.83
Single (frames not modelled)	0.9	8	1	1	0.8	0.66
Single (inclined, frames modelled)	0.9	8	2	1	1	0.76
Single (inclined, frames not modelled)	0.9	8	2	1	0.8	0.60
Single (horizontal, frames modelled)	0.9	8	3	1	1	0.68
Single (horizontal, frames not modelled)	0.9	8	3	1	0.8	0.55
Double Translucent Low-E (frames modelled)	0.74	8	1	1	1	0.68
Double Translucent Low-E (frames not modelled)	0.74	8	1	1	0.8	0.54
Double Translucent Low-E (inclined, frames modelled)	0.74	8	2	1	1	0.62
Double Translucent Low-E (inclined, frames not modelled)	0.74	8	2	1	0.8	0.50
Double Translucent Low-E (horizontal, frames modelled)	0.74	8	3	1	1	0.56
Double Translucent Low-E (horizontal, frames not modelled)	0.74	8	3	1	0.8	0.45

5 CONCLUSIONS

4.2 GENERAL CONSIDERATIONS

The Site is located in a highly accessible position within the northern part of Norwich City Centre and is of strategic importance to the City. Therefore, it has been identified for redevelopment within various planning policy documents. In particular, within Policy GNLP0506 of the emerging Greater Norwich Local Plan, the Anglia Square area is allocated for "residential-led, mixed-use development as the focus for an enhanced and improved large district centre and to act as a catalyst for wider investment and redevelopment within the Northern City Centre strategic regeneration area".

The design has therefore strived to meet the required densification of the area whilst respecting and enhancing its historical character. The proposed building typologies take into consideration and respond to the existing street patterns, defined by alleys, yards and courtyards, and maintain the tight-knit city grain, with its character and human scale.

Such city-centre urban grains are typically associated with lower daylight and sunlight availability on the lower floors, as the surrounding context inherently acts as an obstruction. This is a direct consequence of the character of the area. The area's allocation for redevelopment should be borne in mind, with particular reference to the National Planning Policy Framework ("NPPF", July 2021) which states that, when considering applications for housing, Local Authorities should take a "flexible approach in applying policies or guidance relating to daylight and sunlight, where they would otherwise inhibit making an efficient use of a site".

4.3 CONCLUSIONS ON DAYLIGHT AND SUNLIGHT

DETAILED COMPONENT

In order to ascertain the levels of daylight within the proposed development, a selection of residential units have been assessed for daylight quantum (expressed as Average Daylight Factor or ADF) and distribution (expressed as No Sky Line or NSL, and Room Depth Criterion or RDC). Results are provided in Section 7 of this report.

The selection includes units on the lowest residential storeys, as a worst-case scenario. The daylight and sunlight availability will increase on the upper floors, where the sky visibility is greater.

The results show that 67% (396) of the 594 tested rooms will meet or exceed the levels of ADF recommended by the BRE Guidance. 46 additional LKDs, whilst technically falling short of the 2% ADF recommended for multi-use rooms including a kitchen, would meet or exceed the 1.5% recommended for living rooms and so can be considered acceptably daylit living areas. Should these rooms be included in the overall percentage, this would increase to 75% (445).

As discussed above these percentage refer to a worst-case scenario and therefore, should all habitable rooms within the scheme be assessed, the level of compliance would increase further.

The sky visibility (NSL) is typically restricted on the lowest floors within any urban environment and this is especially true where balconies are also provided. The NSL assessment indicates that, for the selection of rooms assessed, 55% will see levels of sky visibility in line with or above the recommendation. However, the upper floors will have progressively greater levels of sky visibility due to the reduced external obstructions. It should also be noted that a number of rooms fall short marginally and 77% of the rooms within the assessed selection would have a direct view of the sky from at least 50% of their area. Whilst lower than the recommended 80%, this can be considered in line with expectations within dense urban environments.

Finally, most rooms have been designed in accordance with the RDC where applicable, allowing for a good distribution of the daylight available.

Overall, with the majority of habitable rooms on the lowest residential storeys achieving adequate levels of daylight and the upper floors expected to have a better performance, the proposed scheme can be considered acceptable in terms of internal daylight.

With regard to sunlight, the BRE state that it is most appreciated in living areas and the greatest expectation of sunlight is within south-facing rooms. Therefore, Probable Sunlight Hours (PSH) studies have been undertaken for all assessed living rooms with a window facing within 90° of due south, both annually (APSH) and in winter (WPSH). Results are provided in Section 7 of this report.

Overall, the results show that 118 (75%) of the 158 tested living areas meet or exceed the recommended sunlight levels throughout the year and 119 (75%) will be well sunlit during the winter months. These are considered good levels for a scheme of this size and nature.

More details on each of the detailed plots are provided below.

Building A

Building A is a courtyard shaped building located at the heart of the masterplan. The courtyard configuration facilitates the provision of a communal open space, but inevitably restricts the levels of light available to the inner facades, especially where balconies are also provided. Owing to the proposed urban grain, the external facades also have areas of reduced daylight availability, particularly on the lowest levels.

The daylight availability naturally increases towards the top part of the building and the results show that on the Level 03, the majority of rooms see levels in line with or above guidance. The upper storeys are therefore expected to perform even better.

Some shortfalls are still seen on the Level 03 almost exclusively in combined LKDs, owing to their generous size and provision of balconies. Balconies inherently reduce the daylight and sunlight available to the windows set behind or beneath them, but they provide private open space for the enjoyment of future occupants. This trade off of different type of amenities (daylight and sunlight amenity v open space) is common within any contemporary development of this nature and is generally considered acceptable.

Building B

Building B is comprised of two linear blocks of terraced houses and three units have been assessed.

Good levels of daylight quantity are seen within all the bedrooms assessed, which are all seeing more than twice the recommended minimum ADF.

Despite good or very good levels of light available on the façade in most instances, this was not enough in some cases to light the generously-sized open plan LKDs to the recommended average. However, much greater levels than those reported as an average of the room will be seen in the living room located to the front of the room, closer to the fenestration. The rear part of these rooms accommodates the kitchens, which would rely more on supplementary artificial lighting when in use. This is a common occurrence within contemporary accommodation where the access to natural light within the living areas is prioritised over that of kitchens.

Building C

This is a small linear block of flats, seeing good levels of light, overall.

All bedrooms assessed see ADF levels well above the minimum recommendation. Only three LKDs do not meet the 1.5% ADF recommended for living areas. Shortfalls are mainly driven by the generous room size and the provision of balconies, as already discussed for other plots.

These rooms will receive generous levels of sunlight throughout the year (APSH) and so will appear considerably brighter on sunny days. When looking at the performance within level three, all rooms see levels of daylight and sunlight in excess of the recommended minima.

Building D

This building is located at the edge of the masterplan, but in close proximity to Building A and E. Shortfalls are concentrated exclusively towards these blocks and can be attributed to the tight relationship with them. The performance within the rest of the rooms assessed is well above the minima recommended.

Building J3

Most rooms see good levels of daylight within this building, with isolated shortfalls seen within LKDs. Only one, however, falls short of the 1.5% ADF recommended for living areas, owing to its generous size and provision balconies, as already discussed for other plots.

It should be noted that the majority of the rooms assessed within this building not only meet, but significantly exceed the recommended minima and will therefore offer very good levels of daylight amenity.

Sunlight levels are lower than recommended only in the rooms assessed on the lowest storey, as can be expected within urban contexts. On the second floor, sunlight levels are comfortably above the minima recommended.

Buildings KL and M

Finally, buildings KL and M are also courtyard -shaped, similarly to Building A, and so face similar challenges when considering their daylight and sunlight performance.

Owing to the more open nature of Building M and the greater separation distances between these two buildings and their neighbouring plots, levels of daylight have been found to be greater than those achieved within Building A, overall.

Where shortfalls are seen, these occur for the same reasons already explained, namely the generous size of the rooms, the provision of balconies, the relationship with the adjacent buildings or a combination of these.

In conclusion, the scheme generally offers good daylight and sunlight quality within its residential units, with the majority of rooms meeting or exceeding the recommendation.

Where shortfalls are seen this is due to other design considerations taking priority, such as maintaining the tight-knit character of the area and providing balconies directly off generously-sized LKDs.

OUTLINE COMPONENT

In order to ascertain the potential of the outline plots to provide adequate daylight and sunlight, Vertical Sky Component (VSC) and Annual Probable Sunlight Hours (APSH) assessments have been undertaken on the façades. The results are plotted in false-coloured scales and can be found in Section 8.

As the elevation details are still unknown at this stage, the analyses have considered flat façades without recesses or balconies. Once balconies are introduced, these will inevitably reduce the daylight and sunlight ingress into the rooms behind them (if recessed) or beneath them (if projecting). Whilst this is an accepted trade-off, the design will take this into account when positioning balconies and designing internal layouts and elevations.

The results of the assessments undertaken show that the outline plots enjoy the daylight and sunlight potential typical of any dense urban development. The outer façades generally enjoy very good daylight potential (shown as yellow in the diagrams). Therefore, standard design of internal layouts and elevations in these areas would generally lead to acceptable daylight levels indoors.

The daylight availability is lower on the bottom floors where two façades are in close proximity of one another, and in the inner corners of courtyards, as is typical of the proposed building typologies and density. In these areas, shown as orange to purple in the diagrams, special measures can be implemented at detailed design stage to ensure that the daylight ingress is maximised. Such measures may include generous fenestration, shallow layouts and the careful positioning of balconies and living areas.

Sunlight assessments have been undertaken on the elevations facing within 90° of due south, where the expectation of sunlight is greater. Very good levels of sunlight throughout the year can be seen on all assessed façades. The availability of winter sunlight is also very good on the outer elevations. Where blocks are in close proximity of one another, the lower floors receive lower levels of annual sunlight than recommended and little direct sunlight in winter, as is typical of urban environments where the urban grain restricts the sunlight availability on the lower floors.

Overall, the outline plots are considered to have the potential to offer good daylight and sunlight amenity for the enjoyment of future occupants.

4.4 CONCLUSIONS ON OVERSHADOWING

The BRE guidelines state that, in order for an outdoor space to be well sunlit throughout the year, at least half of its area should receive direct sunlight for two hours or more on 21st March. The proposed areas of public or communal outdoor amenity within the scheme have therefore been assessed against this criterion. In addition, in order to provide a better understanding of the sunlight availability throughout the year, sun exposure assessments have been undertaken for the equinox (21st March) and summer solstice (21st June). The results can be found within Section 9 of this report.

The public realm meets the recommendation and will therefore provide good levels of sunlight, overall.

Anglia Square, located between blocks H and KL, receives good levels of sunlight, especially in summer, and even better levels are seen within Stumps Cross, located at the edge of the masterplan. St. George's Gardens will be more overshadowed in winter and mid-season, but over three hours of direct sunlight will be available in summer, when open spaces are more likely to be utilised.

The ground-level amenity areas within Blocks B and C exceed recommendation and will therefore be well sunlit throughout the year.

The majority of podium-level or courtyard amenity areas well exceed the BRE recommendation, offering excellent sunlight amenity throughout the year. Only two of these areas fall short of guidance; these are the courtyard / podium gardens of Blocks E/F and H (labelled as CY1 and PG7 respectively).

The courtyard of Block E/F (PG7) falls short only marginally, as BRE's recommendation is met only four days later, on 25th March. The sun exposure diagrams show that a large part of the area sees over six hours of direct and sunlight on the equinox, and most of the area does so in summer, when people are most likely to spend time outdoors. It is therefore considered that this area provides good levels of sunlight.

The courtyard of H also sees lower levels than recommended in mid-season, but plenty of direct sunlight is available on the roof terraces provided within the same block.

Finally, good levels of sunlight are available to the roof terraces, overall. Most well exceed the minimum recommendation and the few shortfalls are not considered material, as these areas achieve the recommended levels within a few days from the 21st March.

In conclusion, the proposed masterplan offers very good sunlight amenity within the proposed open spaces, for the enjoyment of future occupants

6 SITE OVERVIEW

Fig. 01: Top view

Detailed blocks (assessed for internal daylight and sunlight)

Outline blocks (assessed for daylight and sunlight potential)

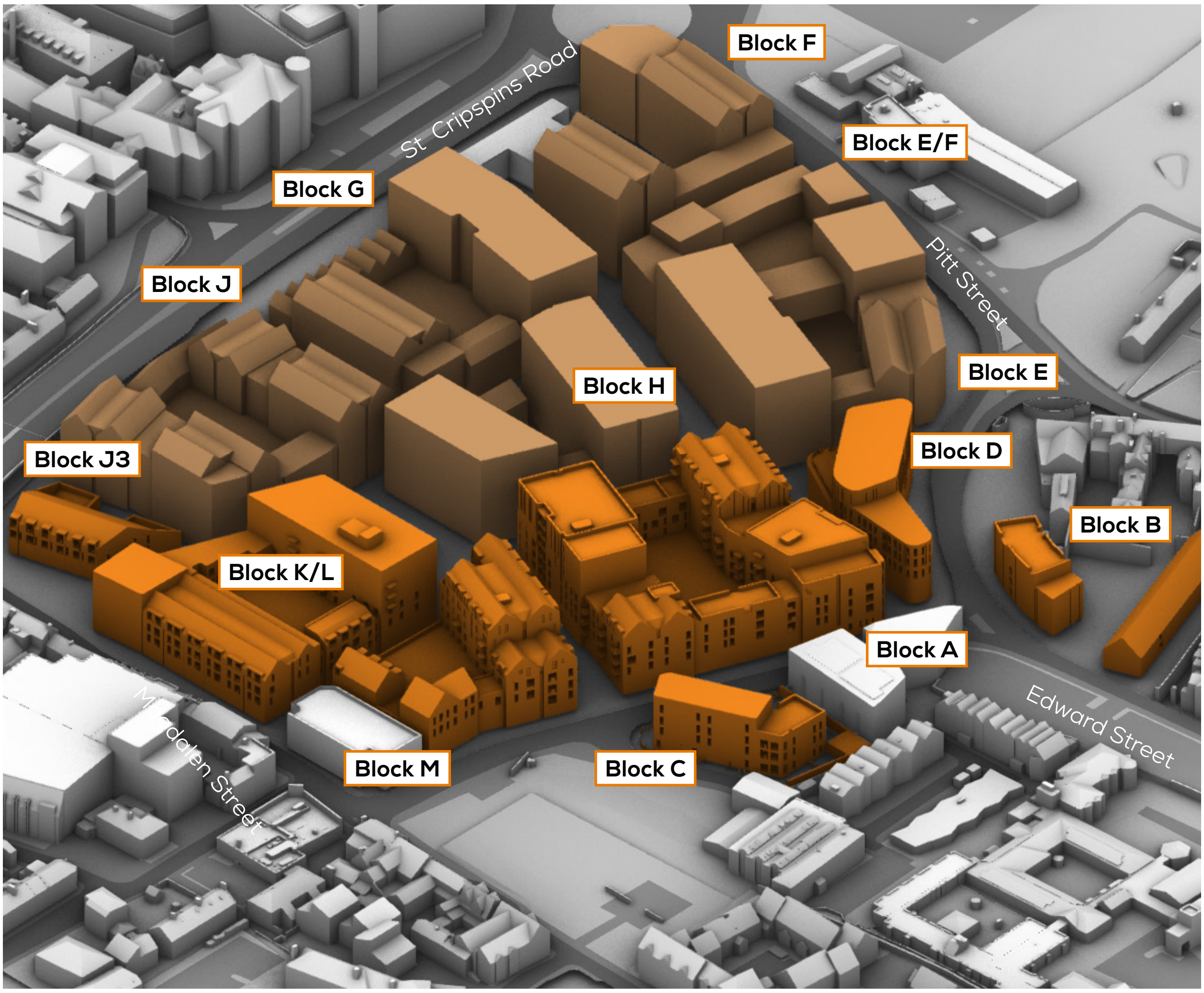

Fig. 02: Perspective view

- Detailed blocks (assessed for internal daylight and sunlight)
- Outline blocks (assessed for daylight and sunlight potential)

7 INTERNAL DAYLIGHT AND SUNLIGHT ASSESSMENTS

KEY TO UNDERSTANDING THE TABLES - DAYLIGHT

DAYLIGHT QUANTUM

Average Daylight Factor (ADF)

Refers to the average percentage of daylight flux in a room against an external unobstructed plane.

BRE recommends ADF levels of 2% for rooms with kitchens (including LKDs and studios with kitchens), 1.5% for living rooms and studies, and 1% for bedrooms.

ROOM REF.	ROOM USE	DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM (PROBABLE SUNLIGHT HOURS)	
		ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
Building C - SIXTH FLOOR						
686	L/K/D	2.8	99	N/A		
687	L/K/D	2.5	100	N/A	78	27
688	Bedroom	1.1	90	MET		
689	Bedroom	1.4	87	MET		
690	Bedroom	1.4	89	MET		
691	Bedroom	2	85	N/A		
692	Bedroom	1.6	82	MET		
693	Bedroom	1.4	95	MET		
694	Bedroom	1.6	98	MET		
695	Bedroom	2.2	93	N/A		
696	Living Room	2.6	100	N/A	56	24
697	Bedroom	2.5	100	N/A		
698	Bedroom	2.3	97	MET		
699	L/K/D	1.3	95	MET	57	28
700	Living Room	1.8	96	N/A	64	27
701	Bedroom	1.4	98	MET		
702	Living Room	1.2	96	MET	39	14

DAYLIGHT DISTRIBUTION

No-SkyLine (NSL)

Refers to the percentage of the room with a view of the sky from a working plane at desk hight.

BRE recommends the NSL to be at least 80% for the room to guarantee satisfactory daylight uniformity.

Room Depth Criterion (RDC)

Defines adequate room proportions that enable good distribution of light. It applies to rooms lit by windows in one wall only.

MET : The room meets the Room Depth criterion

NOT MET: The room does not meet BRE's RDC

N/A (Not Applicable): The room is not lit by windows in one wall only, and cannot be assessed by BRE's RDC

KEY TO UNDERSTANDING THE TABLES - SUNLIGHT

ROOM REF.	ROOM USE	DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM (PROBABLE SUNLIGHT HOURS)	
		ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
Building C - SIXTH FLOOR						
686	L/K/D	2.8	99	N/A		
687	L/K/D	2.5	100	N/A	78	27
688	Bedroom	1.1	90	MET		
689	Bedroom	1.4	87	MET		
690	Bedroom	1.4	89	MET		
691	Bedroom	2	85	N/A		
692	Bedroom	1.6	82	MET		
693	Bedroom	1.4	95	MET		
694	Bedroom	1.6	98	MET		
695	Bedroom	2.2	93	N/A		
696	Living Room	2.6	100	N/A	56	24
697	Bedroom	2.5	100	N/A		
698	Bedroom	2.3	97	MET		
699	L/K/D	1.3	95	MET	57	28
700	Living Room	1.8	96	N/A	64	27
701	Bedroom	1.4	98	MET		
702	Living Room	1.2	96	MET	39	14

SUNLIGHT QUANTUM

Probable Sunlight Hours (PSH)

Refers to the percentage of total probable hours during a year in which a room receives direct sunlight (%).

BRE states that sunlight is most appreciated in living areas and the greatest expectation of sunlight is within south facing rooms. PSH assessments therefore consider all of the living rooms with a main window facing within 90 degrees of due south.

Annual Probable Sunlight Hours (APSH)

BRE recommends at least 25% of Annual Probable Sunlight Hours for rooms where sunlight is expected.

Winter Probable Sunlight Hours (WPSH)

BRE recommends at least 5% of Winter Probable Sunlight Hours for rooms where sunlight is expected.

Block A

Level 00

		DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM	
ROOM REF.	ROOM USE	ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
BLOCK A - LEVEL 00						
1	Bedroom	1.1	32	MET	14	0
2	Bedroom	0.7	24	MET	8	0
3	Living Room	1.2	66	N/A	14	0
4	Bedroom	0.8	29	MET	7	1
5	Bedroom	0.8	36	MET	15	2
6	Bedroom	1	20	MET	18	4
7	L/K/D	0.5	13	N/A	18	4
8	Living Room	0.8	35	N/A	8	2
9	Bedroom	0.9	40	MET	9	2
10	Bedroom	1	80	MET	4	0
11	L/K/D	2.2	92	N/A	3	0
12	Bedroom	1	41	MET	1	0

Table 02: Assessment Data

Fig. 03: Floor Plan

Block A

Level 01

		DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM	
ROOM REF.	ROOM USE	ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
BLOCK A - LEVEL 01						
13	Bedroom	1.7	97	MET	40	7
14	L/K/D	2.1	98	N/A	31	8
15	Bedroom	1.3	60	MET	13	0
16	Bedroom	1.1	54	MET	14	0
17	L/K/D	0.8	39	MET	13	0
18	Bedroom	1.1	35	MET	12	1
19	Bedroom	1.1	21	MET	11	0
20	L/K/D	1	22	MET	5	0
21	Bedroom	1	36	MET	17	2
22	L/K/D	0.8	30	MET	11	2
23	Bedroom	1.4	42	MET	12	0
24	Living Room	2	73	MET	8	3
25	Bedroom	1.6	76	MET	18	0
26	Bedroom	1	37	MET	5	0
27	Bedroom	1.1	53	MET	18	4
28	L/K/D	1.3	44	MET	12	0
29	Bedroom	1.4	63	MET	18	0
30	Living Room	1.2	44	MET	16	3
31	Bedroom	1.3	32	MET	21	2
32	Bedroom	1.2	40	MET	19	5
33	Living Room	0.9	29	N/A	19	5
34	Bedroom	0.7	11	MET	0	0
35	Bedroom	0.7	5	MET	0	0
36	Living Room	1	45	N/A	15	3
37	Bedroom	1.2	47	MET	14	3
38	Bedroom	0.8	81	MET	8	0
39	L/K/D	2.8	98	N/A	10	0
40	Bedroom	1.8	89	MET	4	0
41	Bedroom	1.9	95	MET	4	0
42	Bedroom	2.4	98	MET	4	0
43	Living Room	0.7	44	MET	15	6
44	Bedroom	2.5	96	MET	7	0
45	Bedroom	1.4	88	MET	27	9
46	L/K/D	2.8	100	N/A	23	8
47	Kitchen	3.1	97	MET	4	0
48	Living Room	1.8	83	MET	15	7
49	Bedroom	1.9	89	MET	33	5
50	L/K/D	0.6	38	MET	13	3
51	Bedroom	2.1	87	MET	4	0
52	Bedroom	2.8	99	MET	4	0
53	Bedroom	2.4	92	MET	5	0
54	Bedroom	2.7	95	MET	5	0
55	L/K/D	2.1	88	N/A	15	1
56	Bedroom	1.1	54	MET	16	1
57	L/K/D	0.7	25	MET	8	4
58	Bedroom	0.8	23	MET	11	2
59	Bedroom	1.4	53	MET	7	0
60	L/K/D	1	27	MET	15	3
61	Bedroom	0.8	22	MET	8	0
62	L/K/D	0.5	14	MET	1	0
63	Bedroom	1.7	55	MET	14	2
64	L/K/D	0.8	22	NOT MET	14	2
65	Bedroom	0.7	18	MET	11	5
66	Bedroom	0.7	14	MET	12	5

Table 03: Assessment Data

Fig. 04: Floor Plan

Block A

Level 01 - continued

		DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM	
ROOM REF.	ROOM USE	ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
67	Bedroom	1.3	29	MET	4	0
68	L/K/D	1.1	30	MET	0	0
69	Bedroom	0.7	12	MET	13	6
70	Bedroom	1.5	38	MET	4	0
71	L/K/D	1.1	23	MET	8	0
72	Living Room	1.2	42	N/A	32	12
73	Bedroom	0.6	37	MET	7	2
74	L/K/D	0.9	17	MET	0	0
75	Bedroom	1	28	MET	0	0
76	Bedroom	0.7	75	MET	9	2
77	L/K/D	1.1	66	N/A	41	11
78	L/K/D	1.1	67	N/A	38	11
79	Bedroom	1.6	81	MET	39	7
80	L/K/D	0.5	30	NOT MET	36	3
81	Bedroom	1.2	73	MET	34	5
82	Bedroom	0.5	29	NOT MET	38	9
83	Living Room	1.5	83	MET	38	11
84	Kitchen	1.5	72	MET	0	0
85	Living Room	1.4	76	MET	41	10
86	Kitchen	1.7	65	MET	0	0
87	Living Room	1.2	62	MET	38	8
88	Kitchen	1.6	54	MET	0	0
89	Living Room	1	49	MET	36	3
90	Kitchen	1.3	44	MET	0	0
91	Bedroom	0.4	21	NOT MET	29	1
92	Bedroom	1.1	52	MET	31	3
93	L/K/D	0.6	80	NOT MET	21	7

Table 04: Assessment Data

Fig. 05: Floor Plan

Block A
Level 02

		DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM	
ROOM REF.	ROOM USE	ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
BLOCK A - LEVEL 02						
94	Bedroom	2	98	MET	47	10
95	L/K/D	2.3	98	N/A	35	9
96	Bedroom	1.5	70	MET	17	0
97	Bedroom	1.3	65	MET	16	0
98	L/K/D	1	43	MET	15	1
99	Bedroom	1.3	45	MET	12	1
100	Bedroom	1.2	28	MET	19	1
101	L/K/D	1	28	MET	14	6
102	Bedroom	1.2	44	MET	19	3
103	L/K/D	1	39	MET	15	3
104	Bedroom	1.6	48	MET	24	3
105	Living Room	2.1	89	MET	17	7
106	Bedroom	1.8	95	MET	23	2
107	Bedroom	1.2	50	MET	6	0
108	Bedroom	1.4	66	MET	19	5
109	L/K/D	1.3	80	MET	21	3
110	Bedroom	1.6	90	MET	22	0
111	Bedroom	1.4	54	MET	21	6
112	Living Room	1.1	34	N/A	24	7
113	Living Room	1.3	64	MET	19	4
114	Bedroom	1.8	66	MET	26	4
115	Bedroom	1.1	35	MET	1	0
116	Bedroom	1	32	MET	2	0
117	Living Room	1.3	46	N/A	18	3
118	Bedroom	1.5	58	MET	19	3
119	Bedroom	1	83	MET	13	1
120	L/K/D	3.2	99	N/A	12	0
121	Bedroom	2.2	96	MET	4	0
122	Bedroom	2.2	96	MET	4	0
123	Bedroom	2.8	99	MET	4	0
124	Living Room	0.8	50	MET	17	7
125	Bedroom	2.9	96	MET	7	0
126	Bedroom	1.6	92	MET	33	11
127	L/K/D	3	100	N/A	31	14
128	Kitchen	3.3	98	MET	4	0
129	Living Room	1.9	88	MET	19	8
130	Bedroom	2.1	93	MET	36	6
131	L/K/D	1.2	75	MET	21	7
132	Bedroom	2.2	87	MET	4	0
133	Bedroom	3	99	MET	4	0
134	Bedroom	2.6	92	MET	5	0
135	Bedroom	3	98	MET	5	0
136	L/K/D	3.5	98	N/A	23	4
137	Bedroom	1.3	64	MET	26	1
138	L/K/D	0.8	33	MET	13	5
139	Bedroom	1	29	MET	15	3
140	Bedroom	1.6	68	MET	9	0
141	L/K/D	1.1	42	MET	17	3
142	Bedroom	0.9	29	MET	10	0
143	L/K/D	0.6	19	MET	1	0
144	Bedroom	2	73	MET	15	2
145	L/K/D	0.8	31	NOT MET	18	3
146	Bedroom	0.8	24	MET	15	5
147	Bedroom	0.8	20	MET	15	5

Table 05: Assessment Data

Fig. 06: Floor Plan

Block A

Level 02 - continued

		DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM	
ROOM REF.	ROOM USE	ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
148	Bedroom	1.4	45	MET	7	0
149	L/K/D	1.1	39	MET	2	0
150	Bedroom	0.8	19	MET	16	6
151	Bedroom	1.7	53	MET	4	0
152	L/K/D	1.1	34	MET	12	0
153	Bedroom	1.4	47	MET	7	0
154	Living Room	1.5	45	N/A	35	15
155	Bedroom	0.7	49	MET	9	3
156	L/K/D	0.9	26	MET	0	0
157	Bedroom	1.2	36	MET	0	0
158	Bedroom	0.8	82	MET	10	2
159	L/K/D	1.3	68	N/A	45	14
160	L/K/D	1.3	79	N/A	40	12
161	Bedroom	1.8	90	MET	47	7
162	L/K/D	0.6	61	NOT MET	46	6
163	Bedroom	1.6	75	MET	39	5
164	Bedroom	0.7	67	NOT MET	43	9
165	Bedroom	2.8	93	MET	0	0
166	Bedroom	2	86	MET	42	9
167	Bedroom	1.9	89	MET	47	11
168	Bedroom	3.4	96	MET	0	0
169	Bedroom	3.4	95	MET	0	0
170	Bedroom	1.5	81	MET	46	8
171	Bedroom	1.2	73	MET	43	5
172	Bedroom	3.1	93	MET	0	0
173	Bedroom	0.5	19	NOT MET	36	3
174	Bedroom	1.3	52	MET	37	6
175	L/K/D	0.8	83	NOT MET	25	8

Table 06: Assessment Data

Fig. 07: Floor Plan

Block A
Level 03

		DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM	
ROOM REF.	ROOM USE	ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
BLOCK A - LEVEL 03						
176	Bedroom	1.5	67	MET	54	14
177	L/K/D	2.4	100	N/A	52	16
178	Bedroom	1.7	89	MET	21	1
179	Bedroom	1.6	85	MET	20	1
180	L/K/D	1.4	54	MET	22	3
181	Bedroom	1.5	64	MET	17	4
182	Bedroom	1.5	63	MET	21	4
183	Bedroom	1.3	37	MET	29	6
184	L/K/D	1.3	31	MET	33	10
185	L/K/D	1.4	54	MET	23	4
186	Bedroom	1.5	66	MET	9	0
187	Bedroom	1.8	58	MET	33	6
188	Living Room	2.6	93	MET	32	8
189	Bedroom	2	98	MET	30	2
190	L/K/D	1.7	99	MET	30	3
191	Bedroom	1.7	80	MET	23	4
192	Bedroom	1.8	73	MET	23	6
193	Living Room	1.5	55	N/A	26	7
194	Bedroom	1.8	98	MET	30	2
195	Living Room	1.8	100	MET	33	5
196	Bedroom	2.2	91	MET	30	5
197	Bedroom	1.8	99	MET	8	0
198	Bedroom	1.6	98	MET	9	0
199	Living Room	1.7	68	N/A	27	4
200	Bedroom	1.9	97	MET	27	4
201	Bedroom	1.3	95	MET	19	2
202	L/K/D	3.8	100	N/A	22	1
203	Bedroom	2.5	96	MET	5	0
204	Bedroom	2.4	96	MET	5	0
205	Bedroom	3	99	MET	5	0
206	Living Room	1.1	65	MET	30	8
207	Bedroom	3.1	96	MET	8	0
208	Bedroom	1.8	94	MET	40	14
209	L/K/D	3.6	100	N/A	57	15
210	Kitchen	3.5	98	MET	5	0
211	Living Room	2.9	98	MET	52	11
212	Bedroom	2.5	96	MET	49	11
213	L/K/D	1.8	91	MET	43	10
214	Bedroom	2.3	87	MET	4	0
215	Bedroom	3.2	99	MET	4	0
216	Bedroom	2.7	92	MET	5	0
217	Bedroom	3.2	98	MET	5	0
218	L/K/D	3	96	N/A	41	6
219	Bedroom	1.5	94	MET	35	4
220	L/K/D	1.5	54	MET	33	6
221	Bedroom	1.2	57	MET	24	4
222	Bedroom	1.9	89	MET	19	2
223	L/K/D	1.7	67	MET	23	4
224	Bedroom	1.2	70	MET	22	3
225	L/K/D	1.1	63	MET	15	0
226	Bedroom	2.2	96	MET	20	2
227	L/K/D	1.2	56	NOT MET	21	3
228	Bedroom	1	59	MET	19	5
229	Bedroom	1	65	MET	18	5

Table 07: Assessment Data

Fig. 08: Floor Plan

Block A

Level 03 - continued

		DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM	
ROOM REF.	ROOM USE	ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
230	Bedroom	1.6	81	MET	11	1
231	L/K/D	1.4	71	MET	4	0
232	Bedroom	1	54	MET	20	7
233	Bedroom	1.8	78	MET	10	2
234	L/K/D	1.3	50	MET	20	3
235	Living Room	1.8	53	N/A	35	15
236	Bedroom	1	92	MET	13	3
237	Bedroom	1.6	58	MET	13	1
238	L/K/D	1.2	37	MET	14	0
239	Bedroom	1.4	50	MET	0	0
240	Bedroom	1.1	92	MET	15	2
241	L/K/D	1.5	73	N/A	45	14
242	L/K/D	1.4	89	N/A	44	13
243	Bedroom	2.2	99	MET	54	8
244	L/K/D	0.8	59	MET	58	10
245	Bedroom	2.1	99	MET	54	15
246	L/K/D	1.8	99	N/A	10	9
247	Bedroom	3.6	100	MET	0	0
248	Bedroom	1.9	96	MET	57	17
249	Bedroom	1.9	93	MET	57	12
250	Bedroom	3.7	100	MET	0	0
251	L/K/D	1.6	67	N/A	4	3
252	Bedroom	0.4	20	NOT MET	33	5
253	Bedroom	1.1	52	MET	30	8
254	L/K/D	1.4	87	NOT MET	51	8

Table 08: Assessment Data

Fig. 09: Floor Plan

Block B

Level 00

		DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM	
ROOM REF.	ROOM USE	ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
BLOCK B - LEVEL 00						
255	Living Room	2.3	76	MET	5	0
256	Kitchen	2.1	56	MET	53	11
257	Living Room	2.2	71	MET	6	0
258	Kitchen	2.5	97	MET	51	11
259	L/K/D	1.4	98	MET	22	1
260	Bedroom	2.2	83	MET	33	2

Table 09: Assessment Data

Fig. 10: Floor Plan

Block B

Level 01

		DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM	
ROOM REF.	ROOM USE	ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
BLOCK B - LEVEL 01						
261	Bedroom	2.1	93	MET	7	0
262	Bedroom	2	92	MET	64	18
263	Bedroom	2.1	93	MET	7	0
264	Bedroom	2.2	96	MET	67	22
265	L/K/D	1.4	98	MET	28	4
266	Bedroom	2.6	91	MET	41	6

Table 10: Assessment Data

Fig. 11: Floor Plan

Block B

Level 02

		DAYLIGHT QUANTUM	DAYLIGHT DISTRIBUTION		SUNLIGHT QUANTUM	
ROOM REF.	ROOM USE	ADF (%)	NSL (%)	RDC	ANNUAL	WINTER
BLOCK B - LEVEL 02						
267	L/K/D	1.4	98	MET	31	6
268	Bedroom	2.8	96	MET	45	8

Table 11: Assessment Data