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mansfield bowling club

daylight and sunlight report – january 2015

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OBJECTIVE

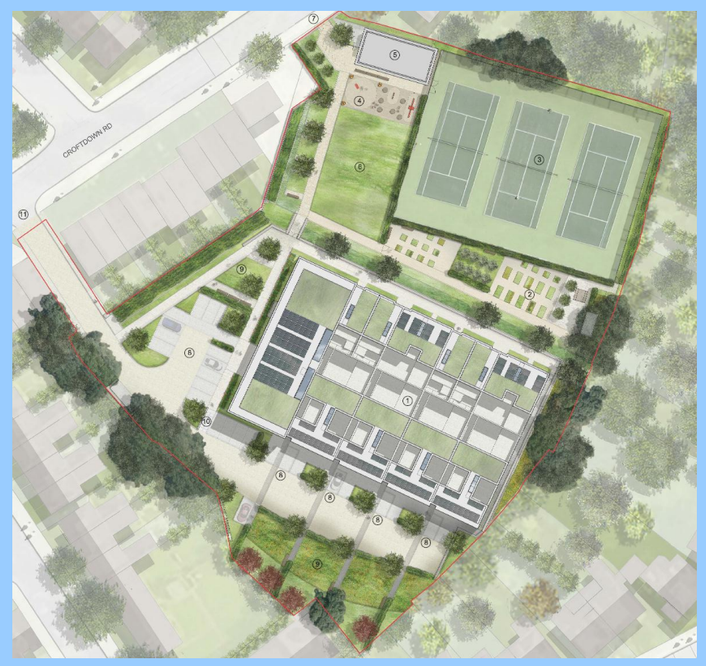
This Daylight and Sunlight Report has been prepared by mTT/SUSTAIN Limited on behalf of Generator Group LLP and forms part of a detailed planning application for the Mansfield Bowling Club redevelopment, addressing the daylighting and sunlighting policies of the London Borough of Camden and in the Code for Sustainable Homes.

The London Borough of Camden advise that 'Where a proposed development has the potential to negatively impact the existing levels of daylight or sunlight on neighbouring properties, a daylight and sunlight assessment will need to accompany the planning application.' This assessment should include meet the criteria outlined in the BRE Report 'Site Layout Planning for Daylight and Sunlight' (BRE 209).

PROJECT BACKGROUND

The proposals comprise the redevelopment of the indoor bowling club to provide 21 residential homes through a combination of houses and flats. In addition, a community tennis club will be retained and improved and publicly accessible open space will be provided.

The form of the building has been developed in response to consultation feedback from resulting a new building only occupying the footprint and volume of the current clubhouse building.



Architects Indicative Plan of the Proposed Mansfield Bowling Club Redevelopment

METHODOLOGY

Overview

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

It assesses the potential daylight and sunlight effects to the surrounding residential properties as a result of proposed redevelopment of the site. In addition, it assesses the likely daylight levels that would be enjoyed to the proposed habitable rooms within the proposed new dwellings at Mansfield Bowling Club.

The assessment has generally been carried out in accordance with the guidance given in Building Research Establishment (BRE) Report 209 'Site Layout Planning for Daylight and Sunlight: A Guide to Good Practice, Second Edition', P J Littlefair (2011). (referred to in this report as BR 209).In addition to the BR 209 tests, the Code for Sustainable Homes also tests the 'no sky line', i.e. the outline on the working plane from which no sky can be seen.

It is noted that BR 209 is a guide whose stated aim 'is to help rather than constrain the designer' and that in its application there may be many other conflicting and potentially more important planning and urban design matters to consider other than simply the provision of idealised levels of daylight and sunlight. Its recommendations do not constitute a test to determine whether a proposed development 'Passes' or 'Fails'.

Internal Assessment (New Dwellings at Mansfield Bowling Club)

BR 209 sets out three key tests for new dwellings: the average Daylight Factor in habitable rooms; the availability of sunlight on to windows with a southerly orientation; and the availability of sunlight to gardens and open spaces.

Accordingly, the review of the proposed new dwellings at Mansfield Bowling Club has been undertaken using three-dimensional computer modelling of the site and the surrounding buildings to:

- Carry out a daylight assessment using the methodologies set out in BR 209 for Average Daylight Factor, No-Sky Line and Room Depth Criterion;
- Carry out a sunlight assessment using the methodologies set out in BRE 209 for Annual Probable Sunlight Hours (APSH) to the fenestration facing within 90 degrees of due south;
- Carry out an overshadowing assessment using the methodologies set out in BR 209 for Sun Hours on Ground;

External Assessment – Impact on Surroundings Buildings

BR 209 also means of assessing the impact of the proposed development on the daylight and sunlight amenity received by the neighbouring buildings.

The assessment is based on the information received from the Design Team and estimates of relevant distances, dimensions and levels which are as accurate as circumstances allow.

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SUMMARY STATEMENT

Internal Assessment (New Dwellings at Mansfield Bowling Club)

In terms of **daylight**, the proposed new dwellings performs reasonably in the context of the need to provide the accommodation only within the footprint and volume of the current clubhouse building. with 39 of the 81 applicable rooms achieving the full levels of Average Daylight Factor recommended by the BRE and in British Standard BS 8206 Part 2 'Code of practice for daylighting'.

The rooms falling short are generally located in the apartment block and the design optimisation has sought to ensure that even those units with levels of daylight below those recommended by the BRE are still daylit to an acceptable level. Only 3 of the 21 dwellings fail to achieve Credits for daylighting in the Code for Sustainable Homes and the requirements for daylighting for a 'home office' are met in 13 if the 21 dwellings.

In terms of **sunlight**, the proposed new dwellings performs extremely well, with all but one of the 21 dwellings receiving levels of Annual Predicted Sunlight Hours in excess of the minimum recommended in the guidance during both the summer and winter - the living room in Plot 20 falls marginally below the threshold in summer. Overall, with all but one of the living rooms seeing excellent levels of sunlight, the proposed scheme performs well in terms of sunlight.

In terms of **overshadowing,** the proposed new dwellings' gardens/courtyards present a design with levels of sunlight that fully satisfy the BR 209 criteria with the gardens/courtyards seeing at least 2 hours of sunlight on 21st March and higher levels throughout the summer. Accordingly, the future occupants will be able to enjoy well sunlit spaces.

The proposed redevelopment is therefore considered to provide residential accommodation which is acceptable in terms of daylight, sunlight and overshadowing considering the high density nature of the design, the footprint and volume constraints building and the surrounding context.

External Assessment – Impact on Surroundings Buildings

The scheme proposals ensure that the new dwellings at the Mansfield Bowling Club site will match the shape and roof heights of the Clubhouse building being replaced. Accordingly, there will be no impacts to surrounding properties in terms of daylight or sunlight as a result of the proposed redevelopment.

The proposed redevelopment is therefore considered justifiable in terms of daylight and sunlight impacts on neighbouring buildings.

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SITE BACKGROUND

This document has been prepared to review the daylight and sunlight issues associated with the proposed redevelopment of the site known as Mansfield Bowling Club, Croftdown Road, London NW5 1EP. The site local planning authority is the London Borough of Camden.

Aerial View of the Existing Site

LOCATION

The surrounding area consists of primarily residential dwellings which are well screened by established landscaping and shrubbery. Specifically, the boundaries of the site sit adjacent to the rear gardens of properties on Croftdown Road, Regency Lawn, Dartmouth Park Avenue, Laurier Road and York Rise.

'The site is accessed via Croftdown Road and has a Public Transport Accessibility Level rating of 3. (moderate) although neighbouring properties have a PTAL rating of 4. The nearest underground station is Tufnell Park, located approximately 750m away.

Site Location Map

1.0 project background…

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EXISTING MANSFIELD BOWLING CLUB SITE DESCRIPTION

The application site comprises a vacant indoor bowling facility which consisted of a six rink indoor bowling green, part 2/part 3 storey clubhouse with associated changing rooms and function room (Class D2).

Two ancillary residential flats (Class C3) are also accommodated in the building. The remainder of the site is made up of associated car parking and hardstanding for the aforementioned vacant building, areas of open space, an outdoor bowling green, two tennis courts and associated clubhouse, and a small allotment area.

The existing site area is approximately 0.85 hectares (ha) or 8,500 square metres.

Photograph of the Existing Mansfield Bowling Clubhouse

PROPOSED MANSFIELD BOWLING CLUB DEVELOPMENT DESCRIPTION

The application is formally for the Creation of a new publicly accessible open space; enhanced tennis facilities including the reconfiguration and extension of the courts to provide an additional court and increased playing area to accord with LTA requirements; the provision of a new ancillary pavilion (Class D2) to replace existing ancillary buildings and structures providing community and leisure space; a new community garden; and the demolition and replacement of the existing bowling club building with a new part three storey, part 2 storey building providing 21 residential dwellings (Class C3) with associated access, parking and landscaping.'

Architects Indicative View of the Proposed Mansfield Bowling Club Redevelopment

2.0 policy background and assessment methodology…

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PLANNING POLICY AND LEGISLATIVE CONTEXT

National Policy

There is no National Policy specifically relating to developments and their potential effects on daylight, sunlight, and overshadowing.

The National Planning Policy Framework (March 2012) has as one of its core principles that planning should 'always seek to secure high quality design and a good standard of amenity'. It does not specifically mention daylight and sunlight.

Paragraph 59 does state that '*However, design policies should avoid unnecessary prescription or detail and should concentrate on guiding the overall scale, density, massing, height, landscape, layout, materials and access of new development in relation to neighbouring buildings and the local area more generally for all existing and future occupants of land and buildings*'.

The Building Research Establishment (BRE) document 'BRE Report 209 Site Layout Planning for Daylight and Sunlight: A Guide to Good Practice 2nd Edition (2011)' is almost universally used as a de facto standard approach in the UK and Ireland for determining whether a development meets good practice standards of daylight and sunlight and for determining the impact of a development on daylight and sunlight availability.

In addition, the British Standard BS 8206-2:2008 Lighting for buildings – Part 2: Code of practice for Daylighting contains guidance on the minimum recommended levels of interior daylighting and introduces some of the calculation procedures used in BRE Report 209.

Regional Policy

The London Plan - Special Development Strategy for Greater London (July 2011), published in July 2011, provides an overall strategic plan for London, and it sets out a fully integrated economic, environmental, transport and social framework for the development of the capital to 2031.

The London Plan gives the following guidance in relation to daylight, sunlight and overshadowing matters:

Policy 3.5 relates to the quality and design of housing developments and states that "*Housing developments should be of the highest quality internally, externally and in relation to their context and to the wider environment, taking account of strategic policies in this Plan to protect and enhance London's residential environment and attractiveness as a place to live.*"

Policy 7.6 relates to architecture and states that *'Architecture should make a positive contribution to a coherent public realm, streetscape and wider cityscape. It should incorporate the highest quality materials and design appropriate to its context.'*

The Policy gives guidance on how planning decisions should be influenced by this Policy and states that:

'Buildings and structures should:

d, not cause unacceptable harm to the amenity of surrounding land and buildings particularly residential buildings, in relation to privacy, overshadowing, wind and microclimate. This is particularly important for tall buildings'

Local Policy

The Camden Development Policies 2010-2025 Local Development Framework document contains the following references to daylight and sunlight amenity:

In Development Policy 26 (DP26) 'managing The Impact of Development on Occupiers and Neighbours' it is stated:

'The council will protect the quality of life of occupiers and neighbours by only granting permission for development that does not cause harm to amenity.

The factors we will consider include:

(a) visual privacy and overlooking;
(b) overshadowing and outlook;
(c) sunlight, daylight and artificial light levels … '

The document goes on to state in paragraph 26.3 Visual Privacy, Overlooking, Overshadowing, Outlook, Sunlight and Daylight: *'A development's impact on visual privacy, overlooking, overshadowing, outlook, access to daylight and sunlight and disturbance from artificial light, can be influenced by design and layout, the distance between properties, the vertical levels of onlookers of occupiers and the angle of views.*

These issues will also affect the amenity of the new occupiers. We will expect that these elements are considered at the design stage of a scheme, to prevent potential negative impacts of the development on occupiers and neighbours. To assess whether acceptable levels of daylight and sunlight are available to habitable spaces, the council will take in to account the standards recommended in the British Research Establishment's 'Site layout planning for daylight and sunlight
– a guide to good practice' (1991).'

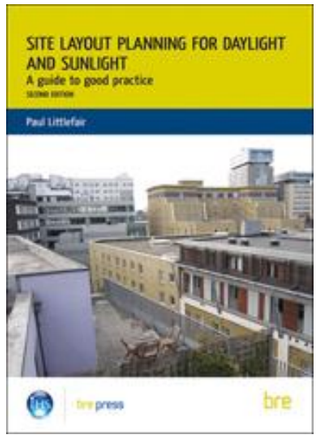
Part one of the Core Strategy adoption document, states in paragraph 5.7 Protecting amenity: *'Camden's high level of amenity – the features of a place that contribute to its attractiveness and comfort – is a major factor in the quality of life of the borough's residents, workers and visitors and fundamental to Camden's attractiveness and success.*

However, Camden's inner London location, and close proximity of various uses and the presence of major roads and railways, can mean that privacy, noise and light can be particular issues in the borough.'

2.0 policy background and assessment methodology…

ASSESSMENT METHODOLOGY

Internal Assessment – Performance of New Dwellings



BRE REPORT BR 209 SITE LAYOUT PLANNING FOR DAYLIGHT AND SUNLIGHT

Overview

The assessment methodology for new building is set out in BRE Report BR 209 Site Layout Planning for Daylight and Sunlight: A Guide to Good Practice 2nd Edition (2011) ('BR 209 ').

The assessment reviewed in this document has been carried out with reference to the second edition of tine report, which was published in October 2011.

Scope

BR 209 advice on site layout planning to achieve good sunlighting and daylighting, both within buildings and in the open spaces between them. This authoritative document is widely used to provide advice during the planning and design stages of building development in the UK and Ireland.

Guidance is also given on site layout for good sunlighting and daylighting; safeguarding of daylight and sunlight within existing buildings nearby; and the protection of daylighting of adjoining land for future development. A special section deals with passive solar site layout. Guidance is given on the sunlighting of gardens and amenity areas.

Its sets out the three key tests for new dwellings: the average Daylight Factor in habitable rooms; the availability of sunlight on to windows with a southerly orientation; and the availability of sunlight to gardens and open spaces.

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

Other References

BR 209 states that it is also intended to be used in conjunction with the British Standard Code of Practice for daylighting. - British Standard BS8206-2:2008 and the Applications Manual on Window Design of the Chartered Institution of Building Services Engineers (CIBSE).

Note on Application

It is noted that BR 209 is a guide whose stated aim 'is to help rather than constrain the designer'. It is not a test to determine whether a development 'Passes' or 'Fails' but a guide to good practice.

The document provides sound general advice, but also clearly states that it 'is not mandatory and this document should not be seen as an instrument of planning policy' It also goes on to acknowledge that *'in special circumstances the developer or planning authority may wish to use different target values.'*

It is also noted in BR 209 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.

Therefore, whilst designers should seek to achieve the numerical targets within the report (e.g. Average Daylight Factor or Annual Predicted Sunlight Hours), the failure to do so does not indicate that the development is unsuitable, nor is it an indication that planning permission should be refused.

CODE FOR SUSTAINABLE HOMES CREDIT HEA 01 DAYLIGHTING

In addition to the BRE tests, the Code for Sustainable Homes also tests the no sky line, i.e. the outline on the working plane from which no sky can be seen.

2.0 policy background and assessment methodology…

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DAYLIGHT

Overview

Various methods for assessing the daylight within a proposed building are set out within section 2.1 and Appendix C of BR 209. These are summarised at the end of section 2.1 of the document, where it states:

'In general, a building will retain the potential for good interior diffused daylighting provided that on all its main faces:
a. No obstruction, measured in a vertical section perpendicular to the main face, from a point two metres above ground level, subtends an angle of more than 25 degrees to the horizontal;

OR

b If (A) is not satisfied, then all points on the main face on a line two metres above ground level are within four metres (measured sideways) of a point which has a vertical sky line component of 27% or more.'

Appendix C of BR 209 gives further detail for these matters and provides alternative methods for assessment to overcome these limitations, most importantly the average Daylight Factor, stating:

'The British Standard for daylighting, and the CIBSE Applications manual: window design, contain advice and guidance on interior daylighting. This guide to good practice is intended to be used in conjunction with them, and its guidance is intended to fit in with their recommendations.'

'For skylight, the British Standard and the CIBSE manual put forward three main criteria, based on the average Daylight Factor, room depth, and the position of the no sky line.'

Average Daylight Factor (ADF)

The Average Daylight Factor (ADF) is a measure of the ratio of the total daylight flux available inside a room relative to the daylight flux available on an unobstructed external horizontal plane.

The ADF takes 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 allows design flexibility so that the provision of larger windows, and higher window head heights, can be used as mitigation against other factors, such as external obstructions limiting the Vertical Sky Component. This is, therefore, a significantly more detailed method of assessment than the Vertical Sky Component method set out above.

The recommended Average Daylight Factor values contained in BR 209 and the British Standard Code of Practice for Daylight are expressed as follows:

*'If a predominantly daylit appearance is required, the Daylight Factor 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 last are minimum values of Average Daylight Factor, and should be attained even if a predominantly daylit appearance is not required.'*

BR 209 states that non-daylit internal kitchens should be avoided, particularly if the space is used as a dining area also. Small internal galley-type kitchens should be directly linked to a well daylit space. Habitable kitchens, i.e. those that are used for other purposes, such as dining, should meet the 2% standard.

Requirements of the Code for Sustainable Homes

The Code for Sustainable Homes imposes a requirement for daylighting within two Credits - Credit Hea 1 Daylighting (where the same parameters as for BR 209 and the British Standard Code of Practice for Daylight above are applied, but only to living rooms, dining rooms and studies (including any room designated as a home office under Credit Ene 9 Home Office) and CSH Credit Ene 9 Home Office, where 'the space dedicated for use as a home office must… achieve an average Daylight Factor of 1.5%'.

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.

The guidance also notes that 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.

2.0 policy background and assessment methodology…

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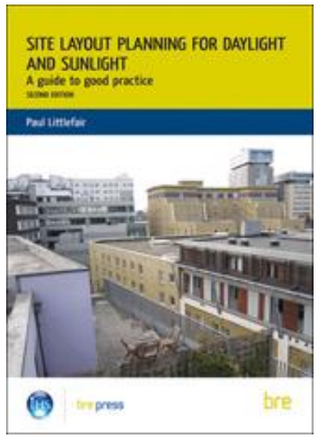
External Assessment – Impact on Neighbouring Buildings



BRE REPORT BR 209 SITE LAYOUT PLANNING FOR DAYLIGHT AND SUNLIGHT

Overview

Assessment methodologies for the impact new buildings on existing neighbouring buildings is also set out in BRE Report BR 209 Site Layout Planning for Daylight and Sunlight: A Guide to Good Practice 2nd Edition (2011) ('BR 209').

The 'external' (i.e. impact on neighbours) assessment reviewed in this document has been carried out with reference to the second edition of tine report, which was published in October 2011.

Scope

When assessing any potential effects on the surrounding properties, the BR 209 indicates that only those windows that have a reasonable expectation of daylight or sunlight need be assessed. In particular the paragraph 2.2.2 of BR 209 states:

'The guidelines given here are intended for use for rooms in adjoining dwellings where daylight is required, including living rooms, kitchens and bedrooms. Windows to bathrooms, toilets, storerooms, circulation areas and garages need not be analysed. The guidelines may also be applied to any existing non- domestic building where the occupants have a reasonable expectation of daylight; this would normally include schools, hospitals, hotels and hostels, small workshops and some offices.'

It is noted that the majority of commercial properties do not have a reasonable expectation of daylight or sunlight as they are generally designed to rely on artificial lighting rather than natural daylight or sunlight.

DAYLIGHTING

BR 209 states that:

'*If any part of a new building or extension, measured in a vertical section perpendicular to a main window wall of an existing building from the centre of the lowest window, subtends an angle of more than 25 degrees to the horizontal, then the diffuse daylighting of the existing building may be adversely affected. This will be the case if either:*

- *the 'vertical sky component' (VSC)measured at the centre of an existing main window is less than 27%, and less than 0.8 times its former value; or*
- *The area of the working plane (0.85m above floor level in residential properties) in a room which can receive direct skylight is reduced to less than 0.8 times it former value.*

The guidelines given here are intended for use for rooms in neighbouring dwellings where daylight is required including living rooms, kitchens and bedrooms.

SUNLIGHTING

BR 209 advises that new development should take care to '*safeguard access to sunlight for existing buildings and any non-domestic buildings where there is a particular requirement for sunlight*.

In summary, BR 209 states: '*If a living room of an existing dwelling has a main window facing within 90 degrees of due south, and any part of a new development subtends an angle of more than 25 degrees to the horizontal measured from the centre of the window in a vertical section perpendicular to the window, then the sunlighting of the existing dwelling may be adversely affected. This will be the case if the centre of the window:*

- *receives less than 25% of Annual Probable Sunlight Hours, or less than 5% of annual probable sunlight hours between 21 September and 21 March and*
- *receives less than 0.8 times its former sunlight hours during either period and*
- *has a reduction in sunlight over the whole year greater than 4% of annual probable sunlight hours'.*

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DETERMINING SIGNIFICANCE

The previous edition of BR209 has often been significantly misapplied when determining whether an impact to a development is significant and whether a development should be refused planning permission.

However, page 1 of the BR 209 states *'The advice given (in the report) is not mandatory and guide should not be seen as an instrument of planning policy; its aim is to help rather than constrain the designer. Although it gives numerical guidelines, these should be interpreted flexibly since natural lighting is only one of many factors in layout design.'*

Often, Local Planning Authorities have interpreted the failure of a development to absolutely meet the guideline criteria as an indicator as to whether a development is acceptable. However, this is not the case and the BRE report suggests that the numerical values are purely advisory and there are times where alternative targets may be used, as described in Appendix F of the 2011 Edition of BR 209, for example:

- where the site already has an extant planning permission that the developer wants to vary, the Vertical Sky Component Annual Predicted Sunlight Hours of the permitted scheme may be used as alternative benchmarks;
- in historic city centre environments, it is often not possible to achieve 27% Vertical Sky Component, therefore it is sensible to use a target value consistent with levels of daylight typically experienced in the street. if the new development is to match the scale and size of the existing development;
- where an existing building has windows that are unusually close to the site boundary and taking more than their fair share of light, to ensure that new development matches the height and proportions of existing buildings.

In addition, Appendix I of the 2011 Edition of the BRE Report provides new guidance on how to assess impact, which suggests that a semantic scale can be used to describe the impact, which can then be used help place the impact in context.

The table opposite summarises the impact magnitude criteria as described in the Appendix I of BR 209.

Criteria	Impact Magnitude
Where the decrease in daylight or sunlight fails to meets the guidelines, and one or more of the following scenarios applies: • a large number of windows or large area of open space is affected; • the loss of light is substantially outside the guidelines; • all windows in a particular property are affected; • the affected building or outdoor space has a particularly strong requirement for light, e.g. a living room in a dwelling or a children's playground.	**Major Adverse**
Where the decrease in daylight or sunlight fully meets the guidelines and a larger number of windows or open space are affected; OR Where the decrease in daylight or sunlight fails to meets the guidelines, but one or more of the following scenarios applies: • only a small number of windows or limited area of open space is affected; • the loss of light is only just outside the guidelines; • an affected room has other sources of light; • the affected building or outdoor space has a low level requirement for light.	**Minor Adverse**
Where the increase/decrease in daylight or sunlight fully meets the guidelines and only a small number of windows are affected; AND If there is an increase in daylight or sunlight, the increase is 'tiny'.	**Negligible**
Where the increase in daylight or sunlight is small and/or the number of affected windows or area of open space affected is small.	**Minor Beneficial**
Where the increase in daylight or sunlight is large and/or the number of affected windows or area of open space affected is large.	**Major Beneficial**

Table 1 Impact Magnitude Criteria (adapted from Appendix I of the BRE Report 2011)

Note: Appendix I of BR 209 also suggests the use of the terms 'moderate adverse' and 'moderate beneficial' impacts, but provides no guidance on how to designate these moderate impacts.

2.0 policy background and assessment methodology…

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However the guidance suggests that judgement should be used when classifying impact magnitude.

2.0 policy background and assessment methodology…

REFERENCE DRAWINGS

The assessments presented in this report have been based on the following drawings supplied by PRP Architects.

Drawing No.	Drawing Title	Date
2101 AA4437	Existing Site Layout	December 2014
2102 AA4437	Existing Site Sections AA, BB	December 2014
2103 AA4437	Existing Site Sections CC, DD	December 2014
2104 AA4437	Existing Ground Floor	December 2014
2105 AA4437	Existing First Floor	December 2014
2106 AA4437	Existing Second Floor	December 2014
2107 AA4437	Existing Roof Plan	December 2014
2110 AA4437	Existing Elevations, North-West, South-West	December 2014
2111 AA4437	Existing Elevations North - East, South - East	December 2014
2120 AA4437	Demolition Plan	December 2014
2121 AA4437	Footprint of Existing Structures	December 2014
2130 AA4437	Proposed Roof Level Masterplan	December 2014
2131 AA4437	Proposed Ground Level Masterplan	December 2014
2135 AA4437	Proposed Site Sections AA, BB	December 2014
2136 AA4437	Proposed Site Sections CC, DD	December 2014
2140 AA4437	Proposed Site Sections EE, FF	December 2014
2145 AA4437	Storey Heights	December 2014
2160 AA4437	Proposed Block Plan - Ground Level	December 2014
2161 AA4437	Proposed Block Plan - First Floor	December 2014
2162 AA4437	Proposed Block Plan - Second Floor	December 2014
2163 AA4437	Proposed Block Plan - Roof Level	December 2014
2164 AA4437	Proposed Block Plan - Basement Level	December 2014
2170 AA4437	GA Elevations North - West, South - West	December 2014
2171 AA4437	GA Elevations North - East, South - East	December 2014
2175 AA4437	Sections AA, BB	December 2014
2176 AA4437	Sections CC, DD	December 2014

Table 1 – Plans and Elevation Drawings Supplied by PRP Architects

3.0 internal assessment – performance of new dwellings…

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OBJECTIVE

In accordance with the commentary in **section 2.0 policy background and assessment methodology**, this section of the report presents the analysis undertaken and results of the studies for Mansfield Bowling Club for:

- Daylight assessment using the methodologies set out in BR 209 for Average Daylight Factor, No-Sky Line and Room Depth Criterion
- Sunlight assessment using the methodologies set out in BRE 209 for Annual Probable Sunlight Hours (APSH) to the fenestration facing within 90 degrees of due south
- Overshadowing assessment using the methodologies set out in BR 209 for Sun Hours on Ground for the gardens/courtyards
- Daylight assessment in the context of the Code for Sustainable Homes Credits Hea 1 Daylighting and Ene 9 Home Office

SPECIFIC METHODOLOGY

Overview

In order to undertake the daylight and sunlight assessments for the new dwellings, a three dimensional computer model using the EDSL Tas Software has been used, based on the scheme drawings provided by PRP Architects.

This allows for a precise model, ensuring that the analysis accurately represents the amount of daylight and sunlight available to the building facades, internal and external spaces..

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.

Sources of Information

The Architect's plans, elevations and sections (listed in **section 2.0 policy background and assessment methodology**) site photographs and OS information have been used to estimate as closely as possible the position of buildings and windows within their elevations.

3.0 internal assessment – performance of new dwellings…

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DAYLIGHT ASSESSMENT

Summary of Requirements

BR 209 AND THE BRITISH STANDARD CODE OF PRACTICE FOR DAYLIGHT

The ADF is a measure of the ratio of the total daylight flux available inside a room relative to the daylight flux available on an unobstructed external horizontal plane. The recommended Average Daylight Factor values contained in BR 209 and the British Standard Code of Practice for Daylight are:

- 2% for kitchens
- 1.5% for living rooms
- 1% for bedrooms

BR 209 states that non-daylit internal kitchens should be avoided, particularly if the space is used as a dining area also. Small internal galley-type kitchens should be directly linked to a well daylit space. Habitable kitchens, i.e. those that are used for other purposes, such as dining, should meet the 2% standard.

CODE FOR SUSTAINABLE HOMES

The Code for Sustainable Homes imposes a requirement for daylighting within two Credits - Credit Hea 1 Daylighting (where the same parameters as for BR 209 and the British Standard Code of Practice for Daylight above are applied, but only to living rooms, dining rooms and studies (including any room designated as a home office under Credit Ene 9 Home Office) and CSH Credit Ene 9 Home Office, where *'the space dedicated for use as a home office must… achieve an average Daylight Factor of 1.5%'.*

Analysis Undertaken

Full daylight assessments were undertaken using the EDSL Tas Software within all 81 proposed habitable rooms. As no values for reflectance, transmittance and maintenance factor were specified by the designers, the following values from BS 8206-2:2008, Annex A, tables A.1-A.6 were adopted in the calculations:

- Floor - 20% reflectance
- Walls- 50% reflectance
- Ceilings - 80% reflectance
- Windows - 70% transmittance
- Working plane -0.85m
- Simulation Sky - CIE Overcast sky at Equinox, location London.

All dwellings were modelled to fully establish the daylight performance for all the living rooms, kitchens and bedrooms in the proposed development.

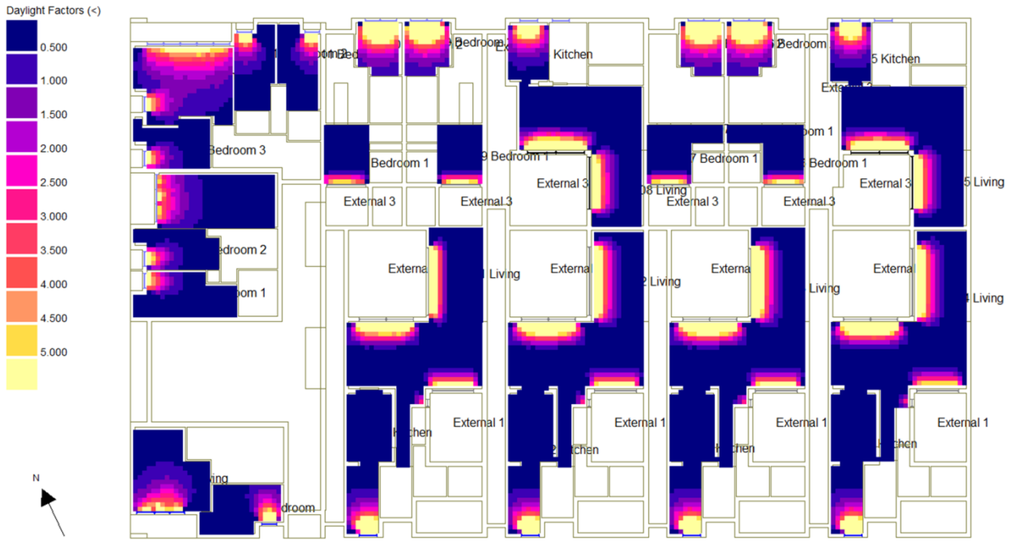
Results

BR 209 AND THE BRITISH STANDARD CODE OF PRACTICE FOR DAYLIGHT RESULTS

Full daylight assessments were undertaken within all 85 proposed residential rooms and the results have shown that 39 (46%) of these rooms are fully compliant with the BRE's recommendations for Average Daylight Factor (ADF).

The ADF results were obtained for each room individually and expressed as a percentage. Where there were two or more windows serving one room the ADF was found separately for each window, and the results summed.

The results are set out in the table in **appendix b** of this report and demonstrate which rooms fully meet the recommended Average Daylight Factor values contained in the British Standard Code of Practice for Daylight. They are summarised on the following page.



Typical Daylight Factor Plot – Ground Floor – refer to appendix b for plots for all floors.

3.0 internal assessment – performance of new dwellings…

…sustainable building services solutions

BR 209 AND THE BRITISH STANDARD CODE OF PRACTICE FOR DAYLIGHT RESULTS

The following table lists the rooms in the proposed new dwellings which fully meet the average Daylight Factor criteria given in BR 209 and the British Standard Code of Practice for Daylight Results. Full details are given in **appendix b**.

Plot/Room	Ave. Daylight factor	Max. Daylight factor	Min. Daylight factor
Plot 01 Bedroom 1	3.5	16.4	0.0
Plot 01 Bedroom 2	3.1	16.0	0.0
Plot 01 Bedroom 3	2.7	24.4	0.0
Plot 01 Bedroom 4	3.0	24.3	0.0
Plot 02 Bedroom 1	3.5	16.4	0.1
Plot 02 Bedroom 2	3.6	18.2	0.0
Plot 02 Bedroom 3	2.9	24.5	0.0
Plot 02 Bedroom 4	3.0	24.3	0.0
Plot 03 Bedroom 1	3.5	16.4	0.1
Plot 03 Bedroom 2	3.5	18.1	0.0
Plot 03 Bedroom 3	2.9	24.4	0.0
Plot 03 Bedroom 4	1.9	20.6	0.0
Plot 03 Living	1.6	12.5	0.0
Plot 04 Bedroom 1	3.6	17.1	0.1
Plot 04 Bedroom 2	3.6	18.2	0.0
Plot 04 Bedroom 3	2.9	24.5	0.0
Plot 04 Bedroom 4	2.9	24.3	0.0
Plot 05 Bedroom 1	4.3	23.3	0.0
Plot 05 Bedroom 2	3.7	15.9	0.0
Plot 05 Bedroom 3	3.1	21.2	0.0
Plot 05 Bedroom 4	2.3	15.3	0.0
Plot 05 Kitchen	2.5	20.8	0.0
Plot 06 Bedroom 2	4.7	21.4	0.0
Plot 06 Living	7.5	24.7	0.1
Plot 07 Bedroom 2	5.0	20.8	0.0
Plot 07 Living	8.0	25.0	0.2
Plot 08 Bedroom 1	4.3	23.6	0.0
Plot 08 Bedroom 2	3.8	20.6	0.0
Plot 08 Bedroom 3	3.1	21.2	0.0
Plot 08 Bedroom 4	2.3	15.3	0.0
Plot 08 Kitchen	2.2	15.4	0.2
Plot 08 Living	1.1	12.2	0.0
Plot 09 Bedroom 2	4.6	21.2	0.0
Plot 09 Living	7.4	24.7	0.1
Plot 10 Bedroom 2	5.0	21.3	0.0
Plot 10 Living	6.1	25.0	0.1
Plot 11 Living	1.7	6.1	0.0
Plot 13 Living	0.8	5.4	0.0
Plot 14 Bedroom 1	1.0	10.5	0.0
Plot 14 Living	1.7	7.1	0.0
Plot 18 Living	1.5	6.3	0.0

3.0 internal assessment – performance of new dwellings…

…sustainable building services solutions

CODE FOR SUSTAINABLE HOMES RESULTS

The following table summarises the performance of the proposed new dwellings against Credit Hea 1 Daylighting and CSH Credit Ene 9 Home Office. Full details are given in **appendix b**.

Plot No.	CSH Credit Hea 1 Credits Achieved Per Dwelling	CSH Credit Ene 9 Credits Achieved Per Dwelling
Plot 01	0	1
Plot 02	0	1
Plot 03	1	1
Plot 04	0	1
Plot 05	1	1
Plot 06	3	1
Plot 07	3	1
Plot 08	1	1
Plot 09	3	1
Plot 10	3	1
Plot 11	2	1
Plot 12	1	0
Plot 13	1	0
Plot 14	2	1
Plot 15	1	0
Plot 16	1	0
Plot 17	1	0
Plot 18	2	1
Plot 19	0	0
Plot 20	0	0
Plot 21	1	0

Conclusion

It is concluded that the proposed new dwellings present a design with maximised levels of daylight and perform well considering the relatively dense nature of the project.

3.0 internal assessment – performance of new dwellings…

…sustainable building services solutions

SUNLIGHT ASSESSMENT

Summary of Requirements

For dwellings the main windows should receive at least 25% of the total annual probable sunlight hours, including at least 5% of the annual probable sunlight hours in the winter months between 21st September and 21st March.

Analysis Undertaken

Full sunlight assessments were undertaken using the EDSL Tas Software for all windows in all living rooms in accordance with the requirements of BR 209.

Results

In all dwellings except Plot 20, the main windows should receive at least 25% of the total annual probable sunlight hours, including at least 5% of the annual probable sunlight hours in the winter months between 21st September and 21st March.

Full details are given in **appendix c**.

Commentary

All proposed elevations within 90 degrees of due south have been assessed for Annual Probable Sunlight Hours (APSH) and the results can be seen in **appendix c** of this report.

The assessments undertaken have shown the levels of APSH to generally be excellent with the great majority of the areas assessed seeing levels of APSH in excess of the minimum recommended by the BRE both during the summer and winter. However, the living room in Plot 20 falls marginally below the threshold.

Conclusion

Overall, with all but one of the living rooms seeing excellent levels of sunlight, the proposed scheme performs well in terms of sunlight.

3.0 internal assessment – performance of new dwellings…

…sustainable building services solutions

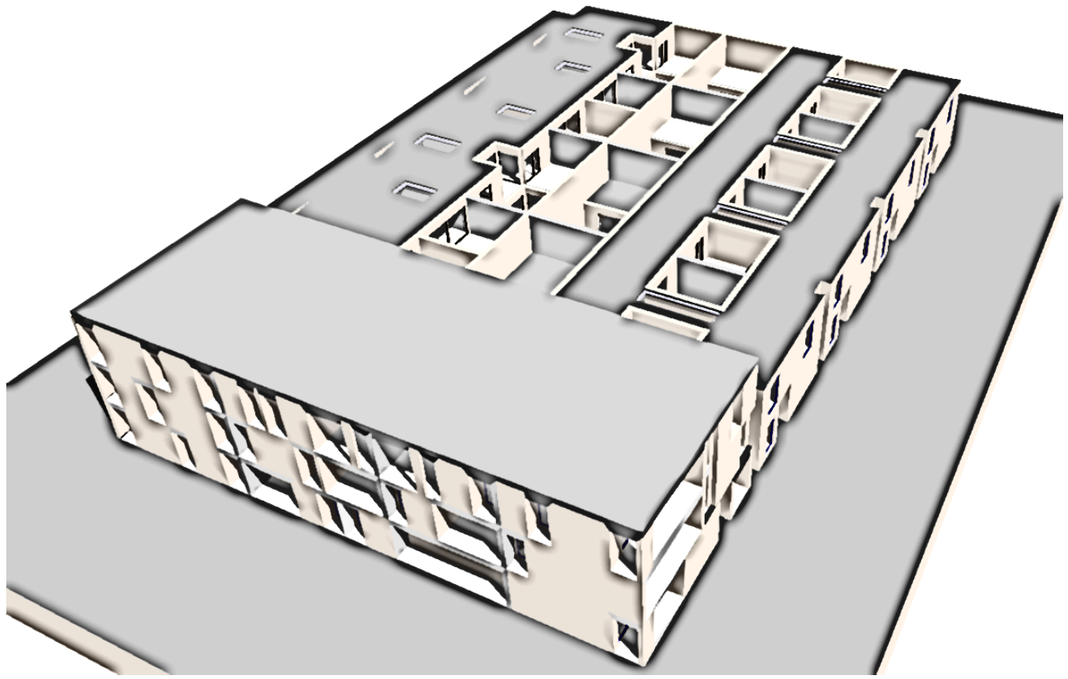
OVERSHADOWING ASSESSMENT (GARDENS/COURTYARDS AND OPEN SPACES)

Summary of Requirements

BR 209 states that for a space to appear adequately sunlit throughout the year at least half of the garden or amenity area should receive at least 2 hours of sunlight on 21st March.

Analysis Undertaken

The new dwellings were been modelled in three dimensions using the EDSL Tas Software.



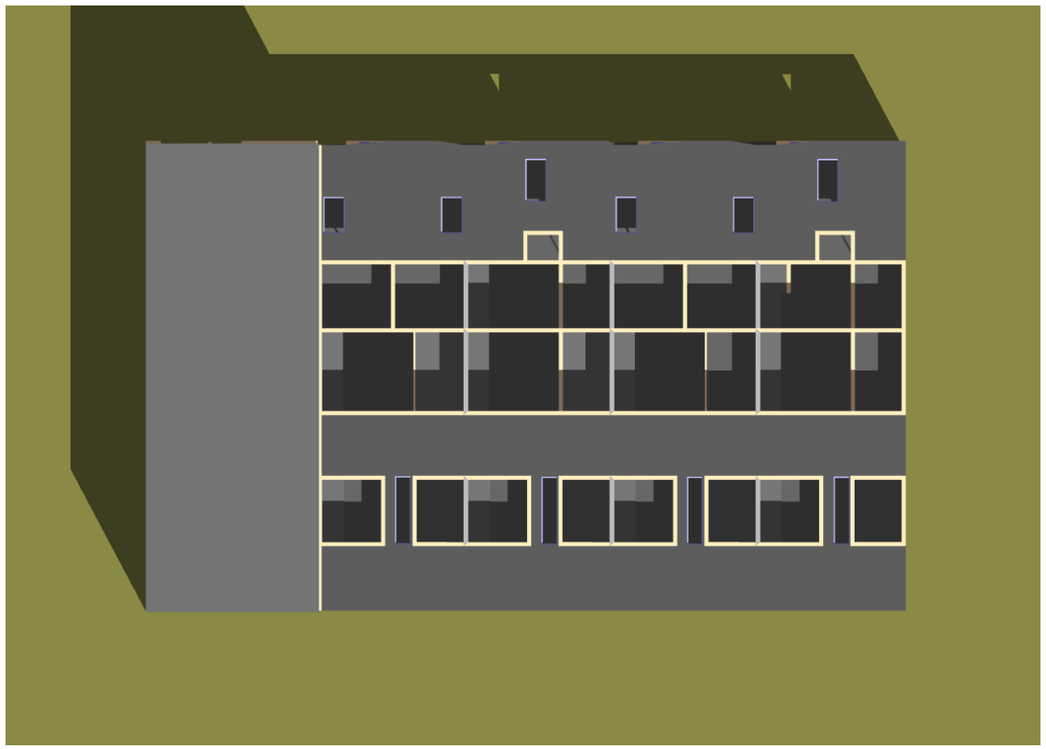
Mansfield Bowling Club Model Isometric Image from Tas Software

A graphical sun shading simulation was then carried out to study the shading occurred on the 21st of March for each hour of the day.

Results

The sun shading simulation plots are presented in **appendix d** for the daylight hours on March 21st (i.e. 7 AM to 5PM)

These demonstrate that on the 21st of March, the gardens/courtyards are shaded most of the day, but they are sunlit for more than 2 hours a day.



Typical Solar Shading Image for 21st of March from Tas Software

Conclusion

It is concluded that the proposed new dwellings' gardens/courtyards present a design with adequate levels of sunlight and satisfy the BR 209 criteria with the gardens/courtyards seeing at least 2 hours of sunlight. Accordingly, the future occupants will be able to enjoy well sunlit spaces.

It is noted that in the summer months, when these outside spaces are most likely to be utilised, the gardens/courtyards will receive sunlight throughout the day.

OBJECTIVE

4.0 external assessment - impact on neighbouring buildings

…sustainable building services solutions

In accordance with the commentary in **section 2.0 policy background and assessment methodology**, this section of the report presents the analysis undertaken and results of the studies for Mansfield Bowling Club for:

- Loss of sunlight for main living rooms of dwellings, and conservatories to neighbouring dwellings
- Loss of daylight for main living rooms of dwellings, and conservatories to neighbouring dwellings

SPECIFIC METHODOLOGY

Sources of Information

The Architect's plans, elevations and sections (listed in **section 2.0 policy background and assessment methodology**) site photographs and OS information have been used to estimate as closely as possible the position of buildings and windows within their elevations.

Access to the adjoining properties has not been not sought or obtained and therefore have made reasonable assumptions as to the internal layouts of the rooms behind the fenestration. This is normal practice where access to adjoining properties is not available. Unless the building form dictates otherwise,

Surrounding Properties

The daylight and sunlight impact of the proposed development upon all of those residential properties within the vicinity of the site that have the potential to be materially affected in terms of daylight and sunlight.

The analysis covers the following residential properties considered to be relevant:

Address	Use
Croftdown Road	Assumed Residential
Dartmouth Park Avenue	Assumed Residential
Laurier Road	Assumed Residential
York Rise	Assumed Residential (Except Church)

Residential uses represent the most onerous daylight and sunlight conditions.

The location of each of these properties is illustrated on the PRP Architects Site Plan (drawing no. 2100 AA4437), which is contained in **appendix a** of this report.

4.0 external assessment - impact on neighbouring buildings

…sustainable building services solutions

SUNLIGHT AND DAYLIGHT ASSESSMENT

Summary of Requirements

The BR 209 recommends that loss of sunlight should be checked for main living rooms of dwellings, and conservatories, if they have a window facing within 90° of due south.

Scope and BR 209 Initial Test

The initial test in BR 209 identifies if the proposed new buildings could have an adverse effect on the diffuse daylighting and sunlight availability to the existing building.

Following the guidance in BR 209 if no part of the proposed new buildings or extension, measured in a vertical section perpendicular to a main window wall of an existing building from the centre of the lowest window, subtends an angle of more than 25 degrees to the horizontal then the daylight and sunlight availability to the existing window will not be adversely affected.

However, loss of light to existing windows may not be analysed if the distance of each part of the new development from the existing window is three or more times its height above the centre of existing windows, in which case the loss of light will be small.

As the new redevelopment's apartments highest point is 9.5m above ground, there won't be any effect on buildings further than 18.6m (for the houses) or 28.5m (for the apartments) from the proposed development.

The diagram to the right illustrates the 3 x height offset perimeter. This demonstrates that the proposed new buildings would not have an adverse impact on the majority of the existing dwellings even if this were a new build project on a previously empty site.

This initial test is conservative for Mansfield Bowling Club as it does reflect the differing heights and layouts of the buildings in the local area. In the case of Mansfield Bowling Club, the site sits lower than the surrounding houses.

Loss of Sunlight to-Existing Dwellings (if New Construction Replacing Empty Site) – Purple Lines Indicate Facades which fall within 3 x Height of Proposed/Existing Building

4.0 external assessment - impact on neighbouring buildings

…sustainable building services solutions

Analysis Undertaken

FORM OF NEW DWELLINGS

As noted in the Architect's Design and Access Statement (DAS), the design has been developed in response to the feedback from consultation favouring a new building sited within the footprint and volume of the current clubhouse building.

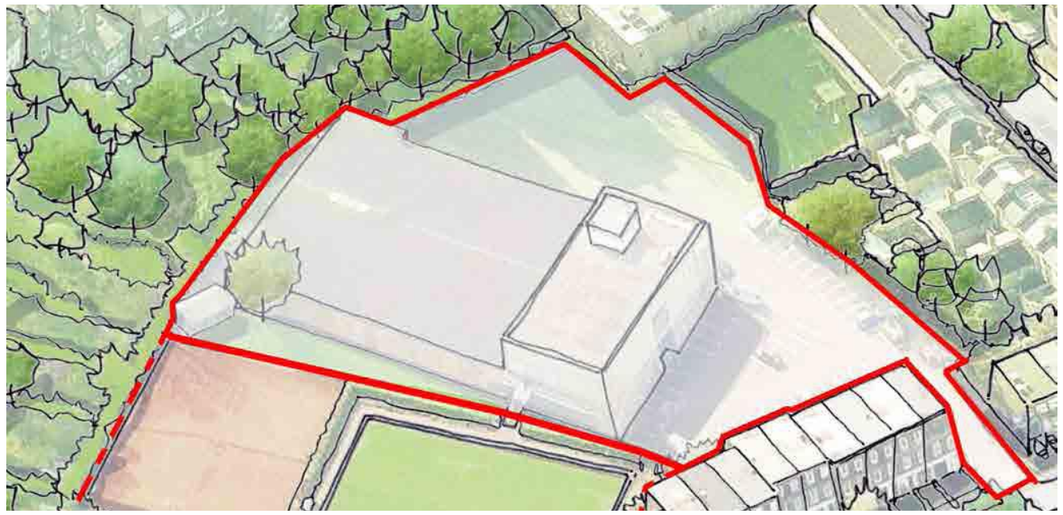
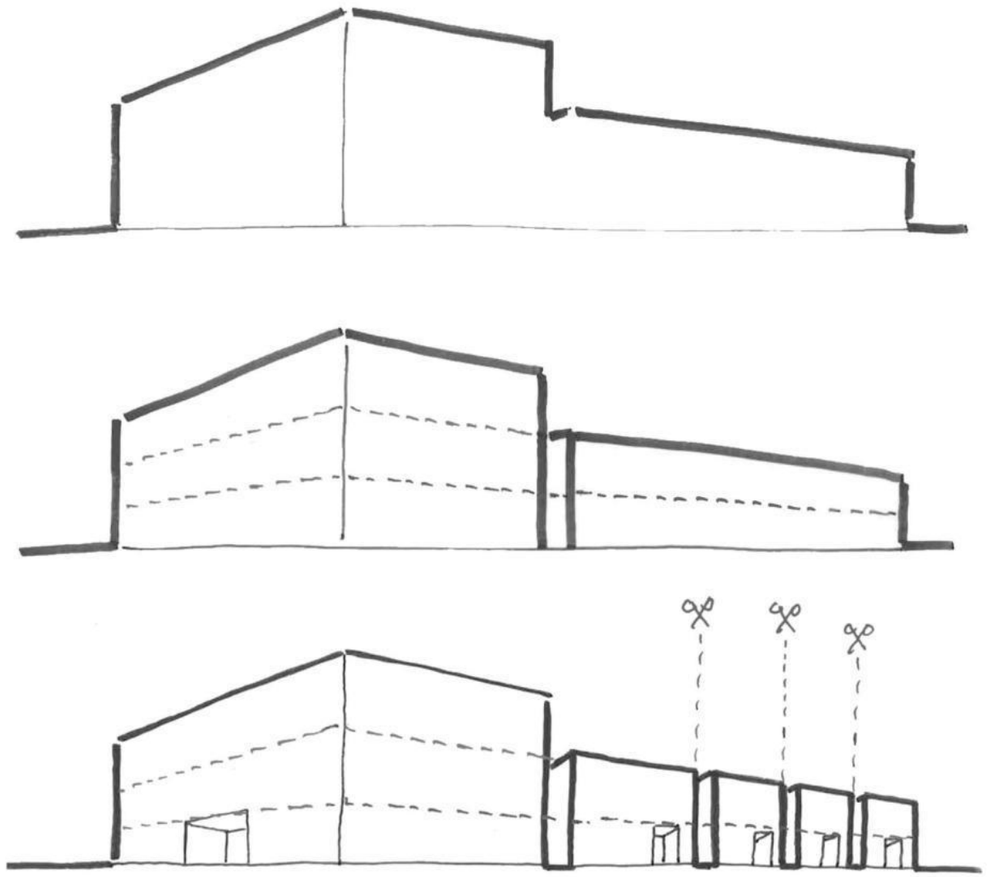


image from PRP Architect's DAS showing Existing Clubhouse Footprint and Volume

Design Development Image from PRP Architect's DAS showing Proposed New Dwellings' Footprint and Volume

ISOMETRIC SKETCHES



Sequence of images from PRP Architect's Pre-Application Presentation Showing Design Development of Scheme – Thick Line indicates existing Clubhouse Roof Profile

4.0 external assessment - impact on neighbouring buildings

…sustainable building services solutions

ELEVATION IMAGES

Extract from PRP Architect's Elevation AA4437/2135 - Red Line indicates existing Clubhouse Roof Profile

Extract from PRP Architect's Elevation AA4437/2135 Red Line indicates existing Clubhouse Roof Profile

These images demonstrate how the new dwellings have been designed to fit within the form of the existing clubhouse and also show that the proposed new dwellings sit substantially lower than the surrounding dwellings and landscaping.

Commentary

SUNLIGHT

The distribution of light in the existing buildings, based on the areas of the working plane which can and cannot receive direct skylight before and after the development requires knowledge of the neighbouring buildings room geometry as the envelope of the proposed new residential redevelopment lies within the footprint and volume of the current clubhouse building.

DAYLIGHT

On the basis of the above, it is also reasonable to assume that daylight distribution in the neighbouring properties will be unaffected by the redevelopment proposals.

Conclusion

The proposed scheme proposals ensure that the new dwellings at the Mansfield Bowling Club site will match the shape and roof heights of the Clubhouse building being replaced.

Accordingly, there will be no impacts to surrounding properties in terms of daylight or sunlight as a result of the proposed works

The proposed redevelopment is therefore considered justifiable in terms of daylight and sunlight impacts on neighbouring buildings.

appendix a – site plan…

…sustainable building services solutions

appendix a…

01 Site Location Plan

notes

- The contractor is responsible for checking dimensions, tolerances and references. Any discrepancy to be verified with the Architect before proceeding with the works.
- Where an item is covered by drawings to different scales the larger scale drawing is to be worked to.
- Do not scale drawing. Figured dimensions to be worked to in all cases.

CDM Regulations 2007

ALL current drawings and specifications for the project must be read in conjunction with the Designer's Hazard and Environmental Assessment Record.

CDM 2007

Note: All survey data provided by Survey Solutions

SITE BOUNDARY

0 5 10 20 30 40 50
SCALE

N

date	rev	revision/author/checker
09-01-15	B	Revised boundary line (EC) (BW)
09-12-14	A	Draft Issue (EC) (BW)

purpose of issue
INFORMATION

project
Mansfield Bowling Club

drawing
Site Location Plan

drawing no
AA4437/2100

rev
B

drawn EC | checked BW

scale @ A1/A3 1:1250/1:2500 | date 22/09/2014

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appendix b – daylighting calculation summary…

…sustainable building services solutions

appendix b…

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Daylighting Analysis - Tabular Output	**Sheet Number:**	1 **of** 1
Assessor:	Lorees Arakelian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

SUMMARY TABLE

MINIMUM CRITERIA: < 1.5% <80%

Plot No.	Room Name	Daylighting Results					Credit Hea 1				Credit Ene 9	
		Average Daylight Factor %	Maximum Daylight Factor %	Maximum Daylight Factor %	% of working plane receiving direct light from the sky		Credits 1,2 Living and Kitchen	Credit 3	Credits Achieved per Dwelling		Room Suitable as Home Office?	Credits Achieved per Dwelling
Plot 1	Plot 01 Bedroom 1	3.5	16.4	0.0	94						YES	
	Plot 01 Bedroom 2	3.1	16.0	0.0	99						YES	
	Plot 01 Bedroom 3	2.7	24.4	0.0	97						YES	
	Plot 01 Bedroom 4	3.0	24.3	0.0	97						YES	1
	Plot 01 Kitchen	1.1	22.5	0.0	44		0				NO	
	Plot 01 Living	1.1	10.9	0.0	33		0	0	0		NO	
	Plot 01 Office	0.2	2.4	0.0	12						NO	
Plot 02	Plot 02 Bedroom 1	3.5	16.4	0.1	95						YES	
	Plot 02 Bedroom 2	3.6	18.2	0.0	99						YES	
	Plot 02 bedroom 3	2.9	24.5	0.0	99						YES	
	Plot 02 Bedroom 4	3.0	24.3	0.0	97						YES	1
	Plot 02 Kitchen	1.1	22.7	0.0	43		0	0	0		NO	
	Plot 02 Living	1.2	11.9	0.0	43		0	0	0		NO	
	Plot 02 Office	0.2	2.5	0.0	12		0	0	0		NO	
Plot 03	Plot 03 Bedroom 1	3.5	16.4	0.1	95						YES	
	Plot 03 Bedroom 2	3.5	18.1	0.0	99						YES	
	Plot 03 Bedroom 3	2.9	24.4	0.0	98						YES	
	Plot 03 Bedroom 4	1.9	20.6	0.0	94						YES	1
	Plot 03 Kitchen	1.1	22.6	0.0	43		0	0	0		NO	
	Plot 03 Living	1.6	12.5	0.0	47		1	0	1		YES	
	Plot 03 Office	0.2	2.5	0.0	12		0	0	0		NO	
Plot 04	Plot 04 Bedroom 1	3.6	17.1	0.1	95						YES	
	Plot 04 Bedroom 2	3.6	18.2	0.0	99						YES	
	Plot 04 Bedroom 3	2.9	24.5	0.0	98						YES	
	Plot 04 Bedroom 4	2.9	24.3	0.0	97						YES	1
	Plot 04 Kitchen	1.1	22.6	0.0	43		0	0	0		NO	
	Plot 04 Living	1.2	13.0	0.0	44		0	0	0		NO	
	Plot 04 Office	0.2	2.4	0.0	12		0	0	0		NO	
Plot 05	Plot 05 Bedroom 1	4.3	23.3	0.0	97						YES	
	Plot 05 Bedroom 2	3.7	15.9	0.0	97						YES	
	Plot 05 Bedroom 3	3.1	21.2	0.0	99						YES	
	Plot 05 Bedroom 4	2.3	15.3	0.0	97						YES	1
	Plot 05 Kitchen	2.5	20.8	0.0	98		1	0	0		YES	
	Plot 05 Living	0.9	9.1	0.0	38		0	0	1		NO	

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Daylighting Analysis - Tabular Output	**Sheet Number:**	1 **of** 1
Assessor:	Lorees Arakelian	**Date:**	9th December 2014
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SUMMARY TABLE

MINIMUM CRITERIA: < 1.5% <80%

Plot No.	Room Name	Daylighting Results				Credit Hea 1			Credit Ene 9	
		Average Daylight Factor %	Maximum Daylight Factor %	Maximum Daylight Factor %	% of working plane receiving direct light from the sky	Credits 1,2 Living and Kitchen	Credit 3	Credits Achieved per Dwelling	Room Suitable as Home Office?	Credits Achieved per Dwelling
Plot 06	Plot 06 Bedroom 1	0.5	5.4	0.0	18				NO	1
	Plot 06 Bedroom 2	4.7	21.4	0.0	99				YES	
	Plot 06 Living	7.5	24.7	0.1	100	2	1	3	YES	
Plot 07	Plot 07 Bedroom 1	0.5	5.3	0.0	19				NO	1
	Plot 07 Bedroom 2	5.0	20.8	0.0	99				YES	
	Plot 07 Living	8.0	25.0	0.2	100	2	1	3	YES	
Plot 08	Plot 08 Bedroom 1	4.3	23.6	0.0	97				YES	1
	Plot 08 Bedroom 2	3.8	20.6	0.0	97				YES	
	Plot 08 Bedroom 3	3.1	21.2	0.0	99				YES	
	Plot 08 Bedroom 4	2.3	15.3	0.0	99				YES	
	Plot 08 Kitchen	2.2	15.4	0.2	100	1	0	0	YES	
	Plot 08 Living	1.1	12.2	0.0	41	0	0	1	NO	
Plot 09	Plot 09 Bedroom 1	0.6	5.4	0.0	23				NO	1
	Plot 09 Bedroom 2	4.6	21.2	0.0	99				YES	
	Plot 09 Living	7.4	24.7	0.1	100	2	1	3	YES	
Plot 10	Plot 10 Bedroom 1	0.5	4.8	0.0	22				NO	1
	Plot 10 Bedroom 2	5.0	21.3	0.0	99				YES	
	Plot 10 Living	6.1	25.0	0.1	100	2	1	3	YES	
Plot 11	Plot 11 Bedroom 1	0.7	8.3	0.0	77				NO	1
	Plot 11 Bedroom 2	0.8	8.5	0.0	84				NO	
	Plot 11 Bedroom 3	0.6	6.3	0.0	69				NO	
	Plot 11 Living	1.7	6.1	0.0	100	1	1	2	YES	
Plot 12	Plot 12 Bedroom 1	0.5	6.5	0.0	53				NO	0
	Plot 12 Bedroom 2	0.7	6.5	0.0	85				NO	
	Plot 12 Living	0.7	5.5	0.0	82	0	1	1	NO	
Plot 13	Plot 13 Bedroom	0.7	7.9	0.0	41				NO	0
	Plot 13 Living	0.8	5.4	0.0	94	0	1	1	NO	
Plot 14	Plot 14 Bedroom 1	1.0	10.5	0.0	88				NO	1
	Plot 14 Bedroom 2	0.9	10.5	0.0	80				NO	
	Plot 14 Bedroom 3	0.6	6.3	0.0	70				NO	
	Plot 14 Living	1.7	7.1	0.0	98	1	1	2	YES	
Plot 15	Plot 15 Bedroom 1	0.5	6.0	0.0	57				NO	0
	Plot 15 Bedroom 2	0.6	6.3	0.0	72				NO	
	Plot 15 Living	0.5	3.5	0.0	75	0	0	0	NO	

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Daylighting Analysis - Tabular Output	**Sheet Number:**	1 **of** 1
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SUMMARY TABLE

MINIMUM CRITERIA: < 1.5% <80%

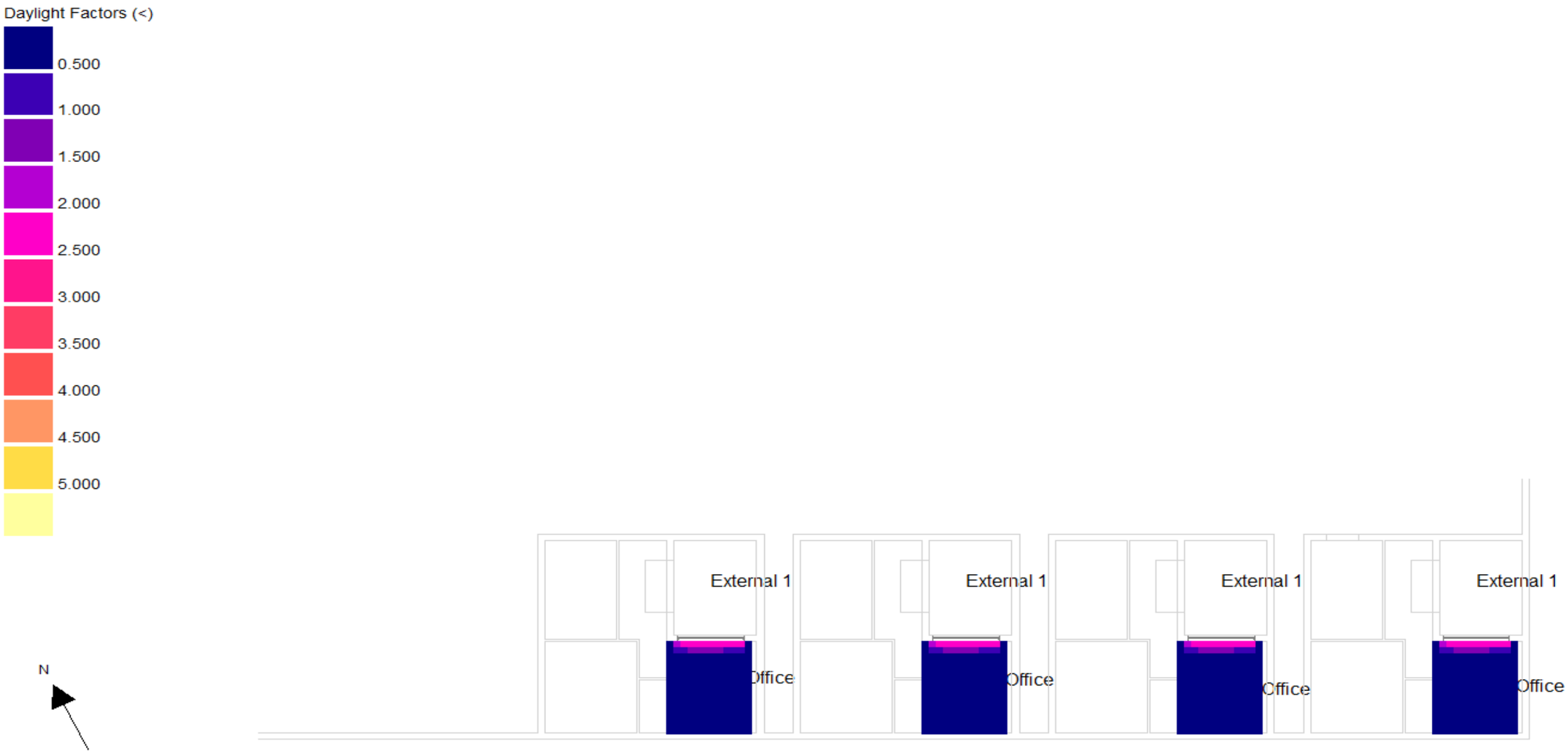
Plot No.	Room Name	Daylighting Results					Credit Hea 1				Credit Ene 9	
		Average Daylight Factor %	Maximum Daylight Factor %	Maximum Daylight Factor %	% of working plane receiving direct light from the sky		Credits 1,2 Living and Kitchen	Credit 3	Credits Achieved per Dwelling		Room Suitable as Home Office?	Credits Achieved per Dwelling
Plot 16	Plot 16 Bedroom	0.6	6.1	0.0	69						NO	0
	Plot 16 Living	0.6	3.4	0.0	81		0	1	1		NO	
Plot 17	Plot 17 Bedroom 1	0.7	7.7	0.0	74						NO	0
	Plot 17 Bedroom 2	0.6	7.1	0.0	60						NO	
	Plot 17 Living	1.3	6.2	0.0	98		0	1	1		NO	
Plot 18	Plot 18 Bedroom 1	0.7	8.7	0.0	77						NO	1
	Plot 18 Bedroom 2	0.8	8.6	0.0	82						NO	
	Plot 18 Bedroom 3	0.6	6.3	0.0	68						NO	
	Plot 18 Living	1.5	6.3	0.0	100		1	1	2		YES	
Plot 19	Plot 19 Bedroom 1	0.6	5.7	0.0	67						NO	0
	Plot 19 Bedroom 2	0.6	6.2	0.0	59						NO	
	Plot 19 Living	0.4	3.0	0.0	68		0	0	0		NO	
Plot 20	Plot 20 Bedroom	0.6	6.3	0.0	70						NO	0
	Plot 20 Living	0.5	3.0	0.0	78		0	0	0		NO	
Plot 21	Plot 21 Bedroom 1	0.8	6.5	0.0	78						NO	0
	Plot 21 Bedroom 2	0.6	6.5	0.0	59						NO	
	Plot 21 Living	1.4	6.4	0.0	96		0	1	1		NO	

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Daylighting Analysis - Graphical Output	**Sheet Number:**	1 to 4 **of** 4
Assessor:	Lorees Arakelian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

DAYLIGHT FACTOR PLOTS

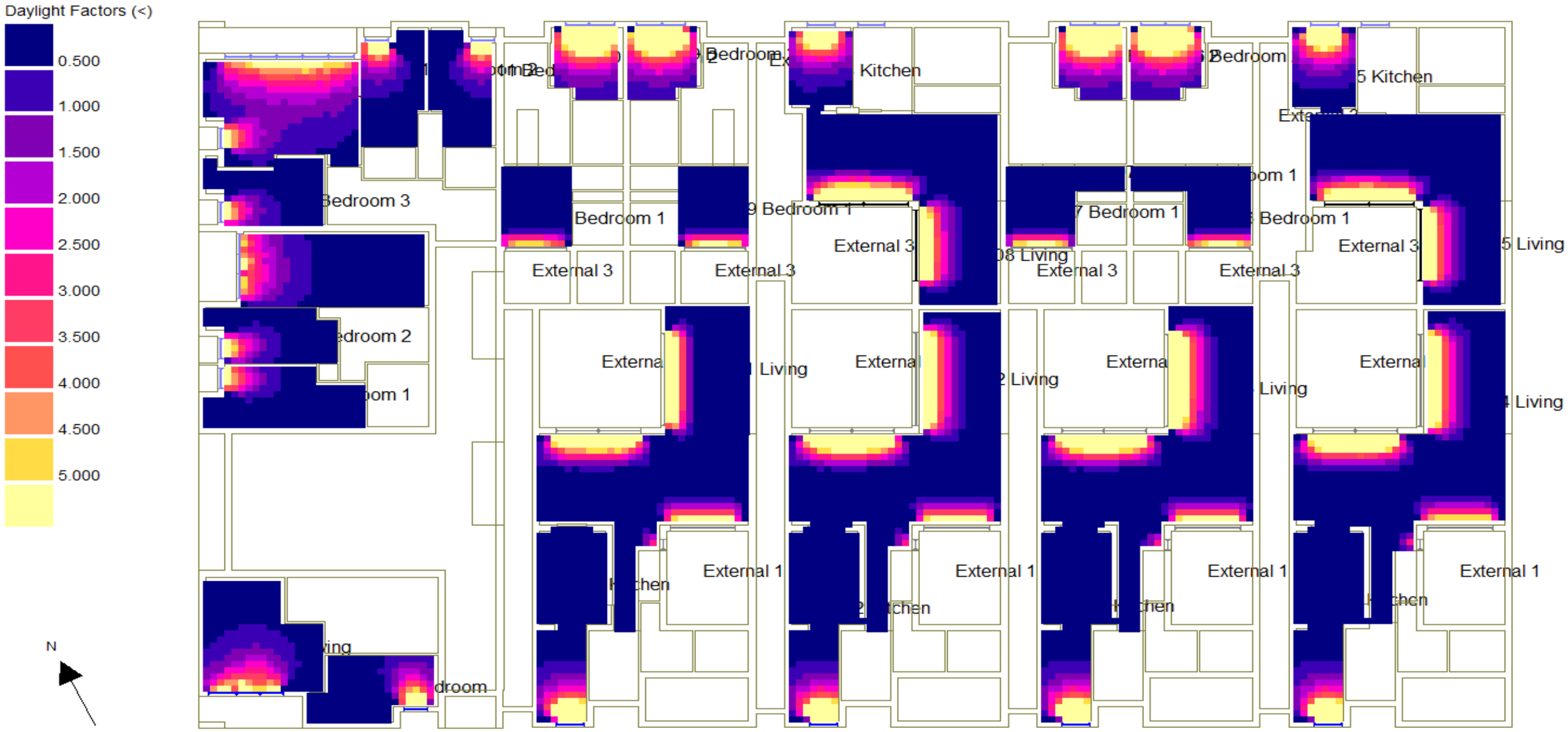
BASEMENT



Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Daylighting Analysis - Graphical Output	**Sheet Number:**	1 to 4 **of** 4
Assessor:	Lorees Arakelian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

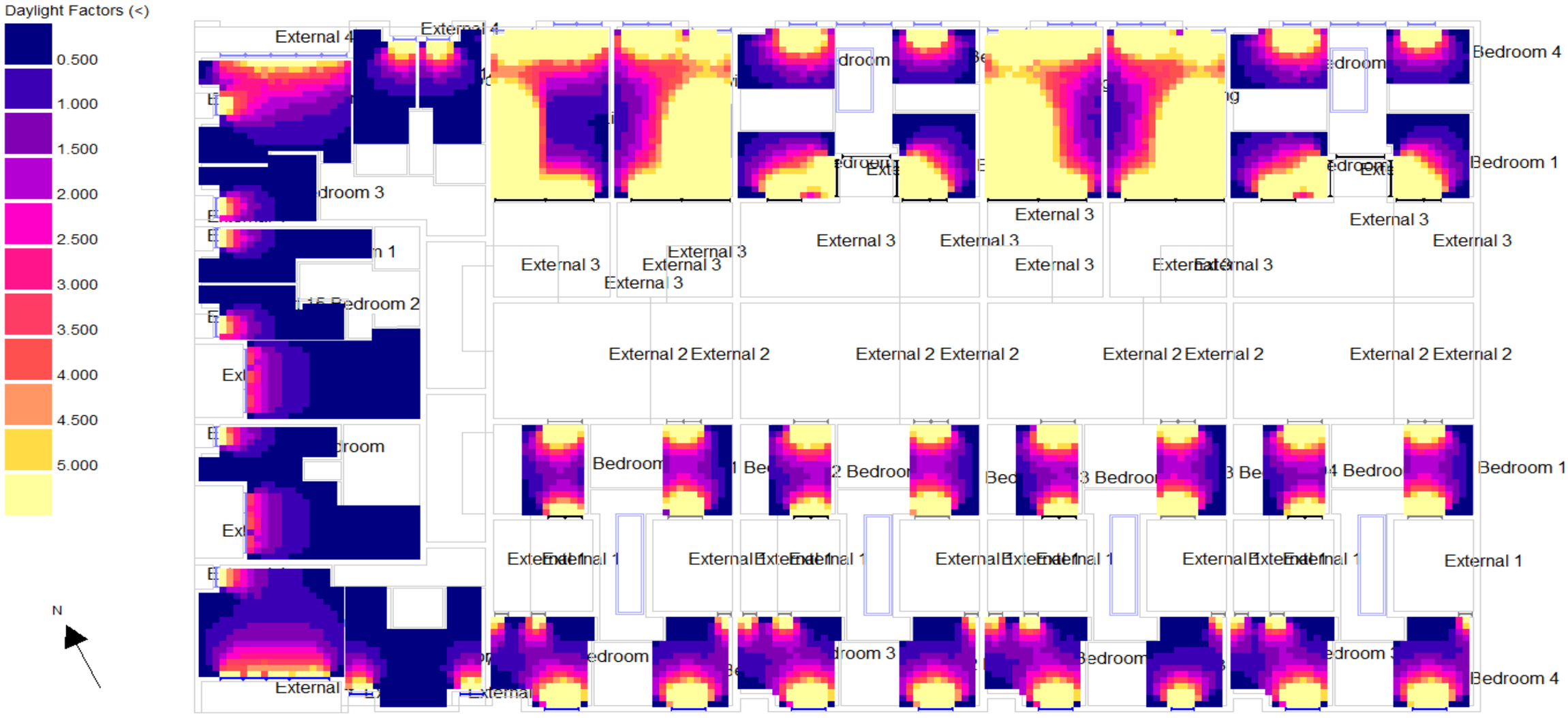
DAYLIGHT FACTOR PLOTS
GROUND FLOOR



Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Daylighting Analysis - Graphical Output	**Sheet Number:**	1 to 4 **of** 4
Assessor:	Lorees Arakelian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

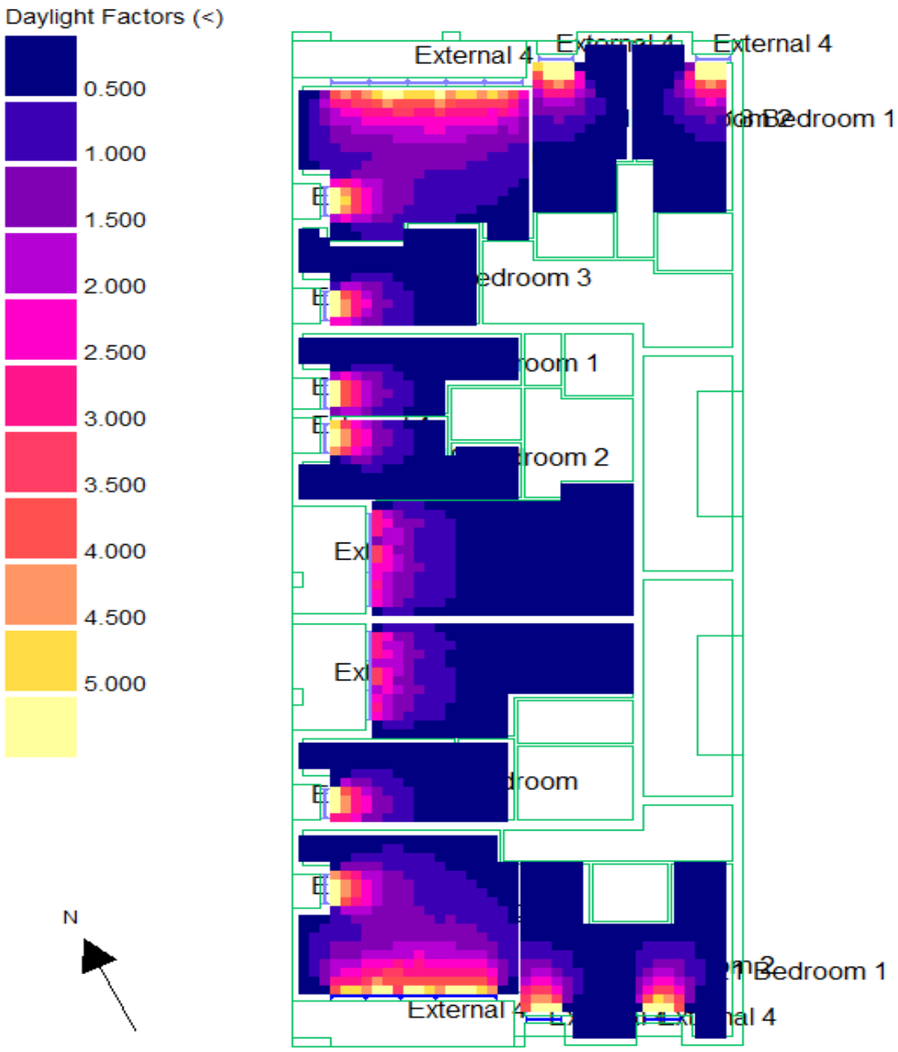
DAYLIGHT FACTOR PLOTS
FIRST FLOOR



Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Daylighting Analysis - Graphical Output	**Sheet Number:**	1 to 4 **of** 4
Assessor:	Lorees Arakelian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

DAYLIGHT FACTOR PLOTS
SECOND FLOOR



appendix c – sunlighting calculation summary…

…sustainable building services solutions

appendix c…

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Annual Predicted Sunlight Hours for the Sunlighting Analysis		
Engineer:	Lorees Arakleian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

RESULTS - SUMMARY

MINIMUM CRITERIA - Red text in table below indicates criteria not met

25.0% 5.0%

Plot No.	Zone Name	Criteria Met for Dwelling?	Zone No.	Surface No.	Mean Altitude m	Area m^2	Total Hours of Solar Availability per Window per Zone												Annual Total (in Applic. Rooms)		Winter Total (in Applic. Rooms)	
							Jan (Winter)	Feb (Winter)	Mar (Winter)	Apr	May	Jun	Jul	Aug	Sep	Oct (Winter)	Nov (Winter)	Dec (Winter)	No.of Hours	%	No.of Hours	%
Plot 1	Plot 01 Bedroom 1	YES	1	6	4.2	3.0	0	0	31	60	124	150	155	155	120	62	0	0				
	Plot 01 Bedroom 1		1	10	4.3	3.3	186	224	279	240	248	240	279	248	240	279	240	217				
	Plot 01 Bedroom 2		2	11	4.3	3.3	0	0	31	60	124	150	155	155	120	31	0	0				
	Plot 01 Bedroom 2		2	6	4.2	3.0	217	196	248	240	186	180	186	186	180	217	270	217				
	Plot 01 Bedroom 3		3	13	4.3	2.4	0	0	31	30	93	150	155	124	30	31	0	0				
	Plot 01 Bedroom 3		3	8	4.3	3.2	217	224	279	300	310	300	310	310	300	279	270	248				
	Plot 01 Bedroom 4		4	5	4.3	1.2	0	0	31	0	93	150	155	124	60	31	0	0				
	Plot 01 Bedroom 4		4	10	4.3	3.2	217	224	279	300	310	300	310	310	300	279	270	248				
	Plot 01 Kitchen		6	10	1.3	2.5	217	224	279	300	310	300	310	310	300	279	270	248				
	Plot 01 Living		5	4	1.3	10.3	31	28	62	90	155	180	155	186	90	62	30	31	**1100**	**28.2%**	**244**	**16.0%**
	Plot 01 Living		5	18	1.3	8.0	0	0	0	60	62	120	155	93	90	0	0	0	**580**	**14.9%**	**0**	**0.0%**
	Plot 01 Living		5	21	1.3	6.3	0	0	124	210	279	240	248	248	240	155	30	0	**1774**	**45.4%**	**309**	**20.2%**
	Plot 01 Living		5	24	1.3	1.0	0	0	62	120	155	180	186	155	90	93	0	0	**1041**	**26.7%**	**155**	**10.2%**
	Plot 01 Office		7	8	-1.8	6.3	0	0	0	0	0	60	31	0	0	0	0	0				
Plot 2	Plot 02 Bedroom 1	YES	8	6	4.2	3.0	0	0	31	60	124	150	155	124	120	62	0	0				
	Plot 02 Bedroom 1		8	10	4.3	3.3	186	224	279	270	279	270	279	279	270	279	240	217				
	Plot 02 Bedroom 2		9	6	4.3	3.3	0	0	31	60	124	150	155	155	120	62	0	0				
	Plot 02 Bedroom 2		9	11	4.2	3.0	186	196	248	270	279	240	248	248	240	248	270	186				
	Plot 02 bedroom 3		10	13	4.3	2.4	0	0	31	30	93	120	124	93	30	31	0	0				
	Plot 02 bedroom 3		10	8	4.3	3.2	217	224	279	300	310	300	310	310	300	279	270	248				
	Plot 02 Bedroom 4		11	5	4.3	1.2	0	0	31	0	93	150	186	124	60	31	0	0				
	Plot 02 Bedroom 4		11	10	4.3	3.2	217	224	279	300	310	300	310	310	300	279	270	248				
	Plot 02 Kitchen		13	10	1.3	2.5	217	224	279	270	310	300	310	310	300	279	270	248				
	Plot 02 Living		12	9	1.3	8.0	0	0	31	60	62	90	124	62	90	31	0	0	**550**	**14.1%**	**62**	**4.1%**
	Plot 02 Living		12	12	1.3	10.4	0	0	31	90	155	180	217	186	120	93	0	0	**1072**	**27.5%**	**124**	**8.1%**
	Plot 02 Living		12	22	1.3	6.3	0	0	93	180	217	210	217	217	240	124	30	0	**1528**	**39.1%**	**247**	**16.2%**
	Plot 02 Living		12	25	1.3	1.0	0	0	62	120	155	180	186	155	90	93	0	0	**1041**	**26.7%**	**155**	**10.2%**
	Plot 02 Office		14	8	-1.8	6.3	0	0	0	0	0	60	31	0	0	0	0	0				

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Annual Predicted Sunlight Hours for the Sunlighting Analysis		
Engineer:	Lorees Arakleian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

RESULTS - SUMMARY

MINIMUM CRITERIA - Red text in table below indicates criteria not met

25.0% 5.0%

Plot No.	Zone Name	Criteria Met for Dwelling?	Zone No.	Surface No.	Mean Altitude m	Area m^2	Total Hours of Solar Availability per Window per Zone												Annual Total (in Applic. Rooms)		Winter Total (in Applic. Rooms)	
							Jan (Winter)	Feb (Winter)	Mar (Winter)	Apr	May	Jun	Jul	Aug	Sep	Oct (Winter)	Nov (Winter)	Dec (Winter)	No.of Hours	%	No.of Hours	%
Plot 3	Plot 03 Bedroom 1	YES	15	5	4.2	3.0	0	0	31	60	124	150	155	124	120	62	0	0				
	Plot 03 Bedroom 1		15	9	4.3	3.3	186	224	279	270	279	270	279	310	270	279	240	217				
	Plot 03 Bedroom 2		16	6	4.3	3.3	0	0	31	60	124	150	155	124	120	62	0	0				
	Plot 03 Bedroom 2		16	11	4.2	3.0	186	196	248	270	279	240	248	248	270	248	270	186				
	Plot 03 Bedroom 3		17	11	4.3	2.4	0	0	31	30	93	120	155	93	60	31	0	0				
	Plot 03 Bedroom 3		17	6	4.3	3.2	217	224	279	300	310	300	310	310	300	279	270	248				
	Plot 03 Bedroom 4		18	10	4.3	1.2	0	0	31	0	93	150	155	124	30	31	0	0				
	Plot 03 Bedroom 4		18	4	4.3	2.1	217	224	279	300	310	300	310	310	300	279	270	248				
	Plot 03 Kitchen		20	10	1.3	2.5	217	224	279	300	310	300	310	310	300	279	270	248				
	Plot 03 Living		19	4	1.3	10.3	0	0	31	90	186	150	217	186	150	62	0	0	**1072**	**27.5%**	**93**	**6.1%**
	Plot 03 Living		19	18	1.3	8.0	0	0	31	60	62	90	155	62	90	31	0	0	**581**	**14.9%**	**62**	**4.1%**
	Plot 03 Living		19	21	1.3	6.3	0	0	93	180	217	210	217	217	210	124	30	0	**1498**	**38.4%**	**247**	**16.2%**
	Plot 03 Living		19	24	1.3	1.0	0	0	62	120	155	180	186	155	90	124	0	0	**1072**	**27.5%**	**186**	**12.2%**
	Plot 03 Office		21	8	-1.8	6.3	0	0	0	0	0	30	62	0	0	0	0	0				
Plot 4	Plot 04 Bedroom 1	YES	22	5	4.2	3.0	0	0	31	60	124	150	155	124	120	62	0	0				
	Plot 04 Bedroom 1		22	9	4.3	3.3	186	224	279	300	279	270	279	310	270	279	270	217				
	Plot 04 Bedroom 2		23	6	4.3	3.3	0	0	31	60	124	150	155	124	120	62	0	0				
	Plot 04 Bedroom 2		23	10	4.2	3.0	186	196	248	270	248	240	248	248	270	248	270	186				
	Plot 04 Bedroom 3		24	11	4.3	2.4	0	0	31	30	93	120	124	93	60	31	0	0				
	Plot 04 Bedroom 3		24	6	4.3	3.2	217	224	279	300	310	300	310	310	300	279	270	248				
	Plot 04 Bedroom 4		25	10	4.3	1.2	0	0	31	60	124	150	186	124	120	62	0	0				
	Plot 04 Bedroom 4		25	4	4.3	3.2	217	224	279	300	310	300	310	310	300	279	270	248				
	Plot 04 Kitchen		27	11	1.3	2.5	217	224	279	270	310	300	310	310	300	279	270	248				
	Plot 04 Living		26	9	1.3	8.0	0	0	31	60	93	150	155	93	90	31	0	0	**703**	**18.0%**	**62**	**4.1%**
	Plot 04 Living		26	12	1.3	10.3	0	0	31	90	186	210	217	186	120	93	0	0	**1133**	**29.0%**	**124**	**8.1%**
	Plot 04 Living		26	22	1.3	6.3	124	140	155	210	217	210	248	217	210	155	180	155	**2221**	**56.9%**	**909**	**59.6%**
	Plot 04 Living		26	24	1.3	1.0	62	84	124	120	124	150	186	155	120	124	120	93	**1462**	**37.4%**	**607**	**39.8%**
	Plot 04 Office		28	8	-1.8	6.3	0	0	0	30	62	120	124	124	60	0	0	0				
Plot 5	Plot 05 Bedroom 1	YES	29	5	4.2	4.0	217	224	279	300	279	300	310	310	300	279	270	248				
	Plot 05 Bedroom 1		29	8	4.3	4.0	62	56	93	150	186	210	186	217	180	124	90	62				
	Plot 05 Bedroom 2		30	7	4.3	4.0	124	168	186	180	217	240	248	217	210	186	180	155				
	Plot 05 Bedroom 2		30	10	4.3	3.3	217	224	279	300	279	300	310	310	300	279	270	248				
	Plot 05 Bedroom 3		31	8	4.3	2.5	0	0	0	60	93	180	186	155	90	31	0	0				
	Plot 05 Bedroom 4		32	6	4.3	2.5	0	0	31	60	124	180	186	155	120	62	0	0				
	Plot 05 Kitchen		34	11	1.3	2.5	0	0	31	60	124	180	186	155	120	62	0	0				

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Annual Predicted Sunlight Hours for the Sunlighting Analysis		
Engineer:	Lorees Arakleian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

RESULTS - SUMMARY

MINIMUM CRITERIA - Red text in table below indicates criteria not met

25.0%	5.0%

Plot No.	Zone Name	Criteria Met for Dwelling?	Zone No.	Surface No.	Mean Altitude m	Area m^2	Total Hours of Solar Availability per Window per Zone												Annual Total (in Applic. Rooms)		Winter Total (in Applic. Rooms)	
							Jan (Winter)	Feb (Winter)	Mar (Winter)	Apr	May	Jun	Jul	Aug	Sep	Oct (Winter)	Nov (Winter)	Dec (Winter)	No.of Hours	%	No.of Hours	%
	Plot 05 Living		33	8	1.3	7.9	0	28	93	120	186	210	217	217	180	124	30	0	**1405**	**36.0%**	**275**	**18.0%**
	Plot 05 Living		33	15	1.3	8.4	155	224	279	270	279	300	310	310	270	279	240	186	**3102**	**79.5%**	**1363**	**89.3%**

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Annual Predicted Sunlight Hours for the Sunlighting Analysis		
Engineer:	Lorees Arakleian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

RESULTS - SUMMARY

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25.0% 5.0%

Plot No.	Zone Name	Criteria Met for Dwelling?	Zone No.	Surface No.	Mean Altitude m	Area m^2	Total Hours of Solar Availability per Window per Zone												Annual Total (in Applic. Rooms)		Winter Total (in Applic. Rooms)	
							Jan (Winter)	Feb (Winter)	Mar (Winter)	Apr	May	Jun	Jul	Aug	Sep	Oct (Winter)	Nov (Winter)	Dec (Winter)	No.of Hours	%	No.of Hours	%
Plot 6	Plot 06 Bedroom 1	YES	35	9	1.3	5.8	93	196	248	270	279	270	310	279	270	248	180	124				
	Plot 06 Bedroom 2		36	5	1.3	4.4	0	0	31	60	124	180	186	155	120	62	0	0				
	Plot 06 Living		37	9	4.3	9.6	217	224	279	300	310	300	310	310	300	279	270	248	**3347**	**85.7%**	**1517**	**99.4%**
	Plot 06 Living		37	13	4.3	8.1	0	0	31	60	124	180	186	155	120	62	0	0	**918**	**23.5%**	**93**	**6.1%**
Plot 7	Plot 07 Bedroom 1	YES	38	11	1.3	5.8	62	196	248	240	279	270	248	279	240	248	210	93				
	Plot 07 Bedroom 2		39	8	1.3	4.4	0	0	31	60	124	180	186	155	120	62	0	0				
	Plot 07 Living		40	13	4.3	9.6	217	224	279	300	279	300	310	310	300	279	270	248	**3316**	**84.9%**	**1517**	**99.4%**
	Plot 07 Living		40	9	4.3	8.1	0	0	31	60	124	150	155	155	90	62	0	0	**827**	**21.2%**	**93**	**6.1%**
Plot 8	Plot 08 Bedroom 1	YES	41	4	4.2	4.0	217	224	279	300	279	270	279	279	300	279	270	248				
	Plot 08 Bedroom 1		41	7	4.3	4.0	62	56	93	150	186	210	186	217	180	124	90	62				
	Plot 08 Bedroom 2		42	5	4.3	3.3	217	224	279	300	279	270	279	279	270	248	270	248				
	Plot 08 Bedroom 2		42	11	4.3	4.0	124	168	186	180	217	240	248	217	210	186	180	155				
	Plot 08 Bedroom 3		43	8	4.3	2.5	0	0	0	60	93	180	186	155	90	31	0	0				
	Plot 08 Bedroom 4		44	5	4.3	2.5	0	0	31	60	124	180	186	155	120	62	0	0				
	Plot 08 Kitchen		46	7	1.3	2.5	0	0	31	60	124	180	186	155	120	62	0	0				
	Plot 08 Living		45	11	1.3	7.9	0	28	93	90	155	210	217	217	180	124	30	0	**1344**	**34.4%**	**275**	**18.0%**
	Plot 08 Living		45	19	1.3	8.4	124	224	279	270	279	270	279	310	240	279	240	186	**2980**	**76.3%**	**1332**	**87.3%**
Plot 9	Plot 09 Bedroom 1	YES	47	9	1.3	5.8	124	196	217	270	217	270	279	248	240	217	180	124				
	Plot 09 Bedroom 2		48	7	1.3	4.4	0	0	31	60	124	180	186	155	120	62	0	0				
	Plot 09 Living		49	9	4.3	9.6	217	224	279	300	279	270	279	310	270	279	270	248	**3225**	**82.6%**	**1517**	**99.4%**
	Plot 09 Living		49	13	4.3	8.1	0	0	31	60	124	180	186	155	120	62	0	0	**918**	**23.5%**	**93**	**6.1%**
Plot 10	Plot 10 Bedroom 1	YES	50	9	1.3	5.8	124	224	217	210	248	180	124	217	240	217	240	124				
	Plot 10 Bedroom 2		51	7	1.3	4.4	0	0	31	60	124	180	186	155	120	62	0	0				
	Plot 10 Living		52	13	4.3	9.6	217	224	248	270	279	270	217	279	270	248	270	248	**3040**	**77.9%**	**1455**	**95.3%**
	Plot 10 Living		52	9	4.3	8.1	0	0	31	60	124	180	186	155	120	62	0	0	**918**	**23.5%**	**93**	**6.1%**
Plot 11	Plot 11 Bedroom 1	YES	53	8	1.3	2.1	0	0	0	0	31	60	62	62	30	0	0	0				
	Plot 11 Bedroom 2		54	5	1.3	2.1	0	0	0	30	62	90	93	62	30	0	0	0				
	Plot 11 Bedroom 3		55	14	1.3	2.1	0	28	62	90	155	180	186	186	120	62	30	0				
	Plot 11 Living		56	5	1.3	2.1	0	0	0	30	93	120	124	124	60	0	30	31	**612**	**15.7%**	**61**	**4.0%**
	Plot 11 Living		56	10	1.3	11.5	0	0	0	60	93	180	124	124	90	31	0	0	**702**	**18.0%**	**31**	**2.0%**
	Plot 11 Living		56	0	1.3	0.5	93	56	124	120	155	150	155	155	150	93	90	62	**1403**	**35.9%**	**518**	**33.9%**
Plot 12	Plot 12 Bedroom 1	YES	57	12	1.3	2.1	0	0	62	120	155	180	155	186	150	93	30	31				
	Plot 12 Bedroom 2		58	10	1.3	2.5	0	28	62	90	155	180	186	186	120	62	30	31				
	Plot 12 Living		59	8	1.3	6.7	31	28	93	120	155	180	186	186	150	93	60	62	**1344**	**34.4%**	**367**	**24.0%**
Plot 13	Plot 13 Bedroom	YES	60	12	1.3	2.1	217	196	248	240	217	240	217	248	240	248	240	217				

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Annual Predicted Sunlight Hours for the Sunlighting Analysis		
Engineer:	Lorees Arakleian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

RESULTS - SUMMARY

MINIMUM CRITERIA - Red text in table below indicates criteria not met

	25.0%	5.0%

Plot No.	Zone Name	Criteria Met for Dwelling?	Zone No.	Surface No.	Mean Altitude m	Area m^2	Total Hours of Solar Availability per Window per Zone												Annual Total (in Applic. Rooms)		Winter Total (in Applic. Rooms)	
							Jan (Winter)	Feb (Winter)	Mar (Winter)	Apr	May	Jun	Jul	Aug	Sep	Oct (Winter)	Nov (Winter)	Dec (Winter)	No.of Hours	%	No.of Hours	%
~~Plot 13~~	Plot 13 Living	~~YES~~	61	13	1.3	6.7	217	224	248	240	217	150	155	186	240	248	240	217	**2582**	**66.1%**	**1394**	**91.3%**

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Annual Predicted Sunlight Hours for the Sunlighting Analysis		
Engineer:	Lorees Arakleian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

RESULTS - SUMMARY

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Plot No.	Zone Name	Criteria Met for Dwelling?	Zone No.	Surface No.	Mean Altitude m	Area m^2	Total Hours of Solar Availability per Window per Zone												Annual Total (in Applic. Rooms)		Winter Total (in Applic. Rooms)	
							Jan (Winter)	Feb (Winter)	Mar (Winter)	Apr	May	Jun	Jul	Aug	Sep	Oct (Winter)	Nov (Winter)	Dec (Winter)	No.of Hours	%	No.of Hours	%
Plot 14	Plot 14 Bedroom 1	YES	62	9	4.3	2.1	0	0	0	30	62	120	155	124	60	0	0	0				
	Plot 14 Bedroom 2		63	12	4.3	2.1	0	0	0	30	62	120	124	93	90	0	0	0				
	Plot 14 Bedroom 3		64	6	4.3	2.5	31	28	62	120	155	180	186	186	150	93	60	62				
	Plot 14 Living		65	17	4.3	2.5	0	0	93	90	155	180	186	186	150	62	30	31	**1163**	**29.8%**	**216**	**14.2%**
	Plot 14 Living		65	22	4.3	11.5	0	0	0	60	93	150	155	124	120	31	0	0	**733**	**18.8%**	**31**	**2.0%**
	Plot 14 Living		65	20	4.7	0.5	93	56	124	120	155	150	155	155	150	93	90	62	**1403**	**35.9%**	**518**	**33.9%**
Plot 15	Plot 15 Bedroom 1	YES	66	11	4.3	2.1	0	0	31	120	155	180	186	186	150	93	30	31				
	Plot 15 Bedroom 2		67	13	4.3	2.5	62	56	93	120	155	180	186	186	150	93	60	62				
	Plot 15 Living		68	11	4.3	6.7	31	28	62	120	155	180	186	155	150	93	60	31	**1251**	**32.0%**	**305**	**20.0%**
Plot 16	Plot 16 Bedroom	YES	69	12	4.3	2.1	0	28	31	120	155	180	186	186	150	93	30	62				
	Plot 16 Living		70	11	4.3	6.2	0	28	62	90	155	180	186	155	120	62	90	31	**1159**	**29.7%**	**273**	**17.9%**
Plot 17	Plot 17 Bedroom 1	YES	71	11	4.3	2.1	217	168	217	210	248	240	217	248	210	186	210	217				
	Plot 17 Bedroom 2		72	9	4.3	2.1	155	168	217	210	248	240	248	248	240	186	210	186				
	Plot 17 Living		73	9	4.3	10.0	217	224	248	270	279	240	248	248	270	248	240	248	**2980**	**76.3%**	**1425**	**93.4%**
	Plot 17 Living		73	14	4.3	2.1	0	0	31	90	155	180	186	186	120	62	30	0	**1040**	**26.6%**	**123**	**8.1%**
Plot 18	Plot 18 Bedroom 1	YES	74	5	7.3	2.1	0	0	31	60	93	120	124	124	90	62	0	0				
	Plot 18 Bedroom 2		75	5	7.3	2.1	0	0	0	30	62	120	93	93	30	0	0	0				
	Plot 18 Bedroom 3		76	12	7.3	2.5	0	28	31	90	124	150	155	155	150	62	30	0				
	Plot 18 Bedroom 3		76	15	7.7	0.5	62	56	93	120	155	150	155	155	150	93	90	62				
	Plot 18 Living		77	6	7.3	2.4	31	28	31	90	124	150	155	155	120	62	30	0	**976**	**25.0%**	**182**	**11.9%**
	Plot 18 Living		77	13	7.3	11.5	0	0	0	60	62	90	124	124	60	31	0	0	**551**	**14.1%**	**31**	**2.0%**
	Plot 18 Living		77	9	7.7	0.5	62	84	93	120	155	150	155	155	150	93	60	93	**1370**	**35.1%**	**485**	**31.8%**
Plot 19	Plot 19 Bedroom 1	YES	78	8	7.3	2.4	0	0	62	90	155	180	186	186	120	62	30	31				
	Plot 19 Bedroom 2		79	12	7.3	2.1	0	28	31	30	93	120	124	124	90	0	0	0				
	Plot 19 Living		80	7	7.3	6.7	31	28	62	90	124	120	124	124	120	62	60	31	**976**	**25.0%**	**274**	**18.0%**
Plot 20	Plot 20 Bedroom	NO	81	10	7.3	2.5	0	28	62	90	124	150	155	155	150	62	60	0				
	Plot 20 Living		82	8	7.3	6.2	31	28	62	90	124	120	124	124	120	62	30	31	**946**	**24.2%**	**244**	**16.0%**
Plot 21	Plot 21 Bedroom 1	YES	83	7	7.3	2.1	155	140	186	240	248	90	124	124	240	186	150	155				
	Plot 21 Bedroom 2		84	8	7.3	2.1	186	140	217	210	217	180	186	217	240	186	210	217				
	Plot 21 Living		85	5	7.3	2.4	31	0	0	60	124	150	155	155	90	31	30	31	**857**	**22.0%**	**123**	**8.1%**
	Plot 21 Living		85	17	7.3	10.0	217	224	279	210	186	150	155	155	210	217	270	248	**2521**	**64.6%**	**1455**	**95.3%**

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Annual Predicted Sunlight Hours for the Sunlighting Analysis		
Engineer:	Lorees Arakleian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

RESULTS - SUMMARY

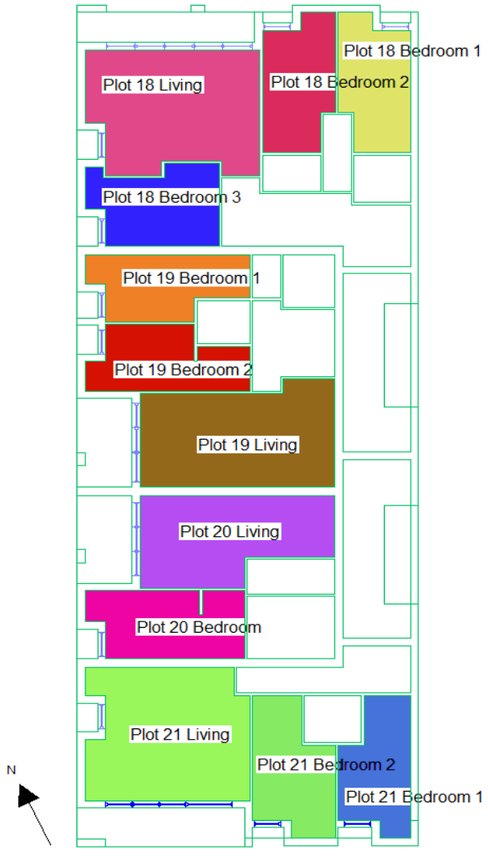
BASEMENT FLOOR

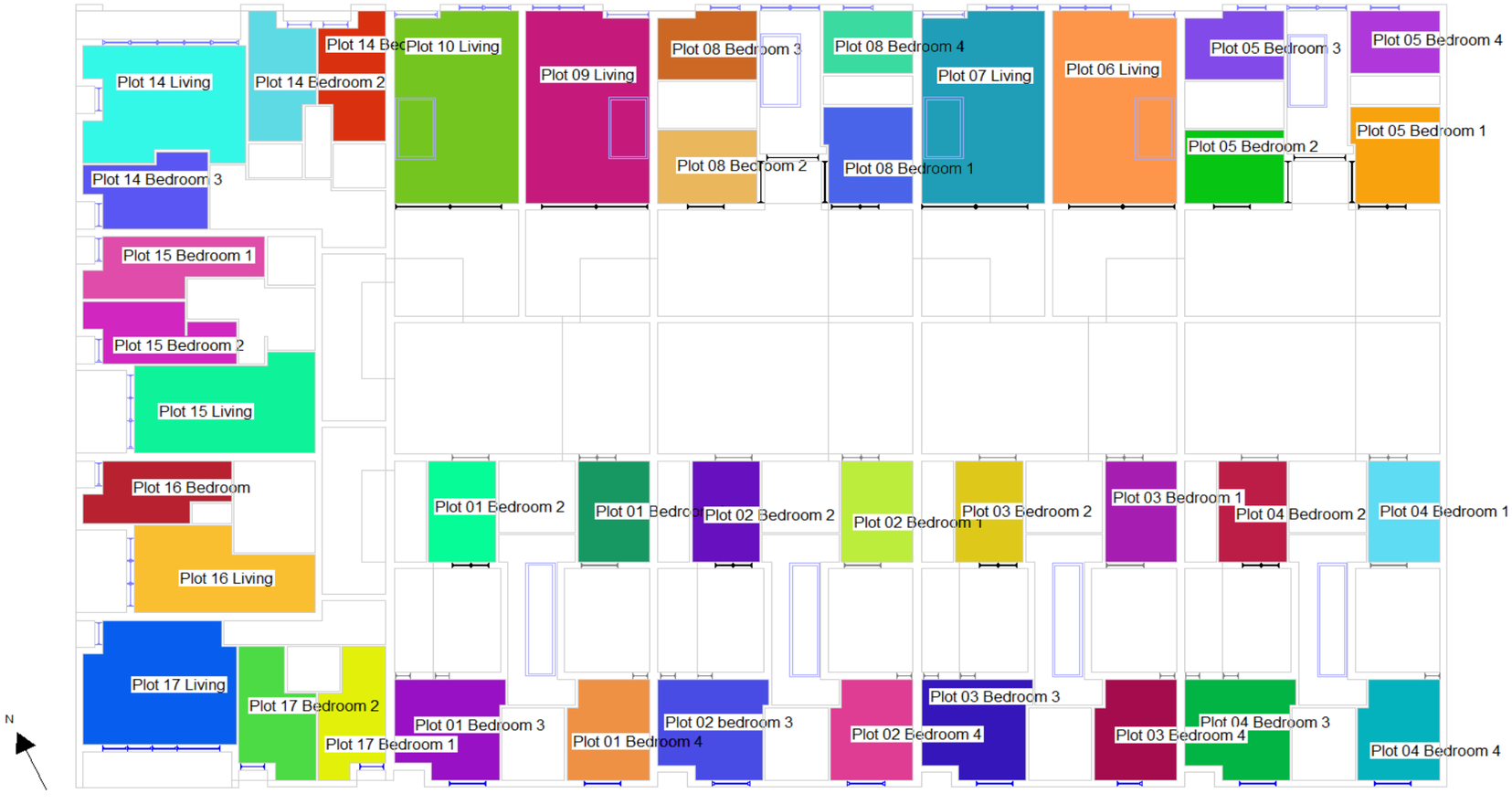
Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Annual Predicted Sunlight Hours for the Sunlighting Analysis		
Engineer:	Lorees Arakleian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

RESULTS - SUMMARY

FIRST FLOOR



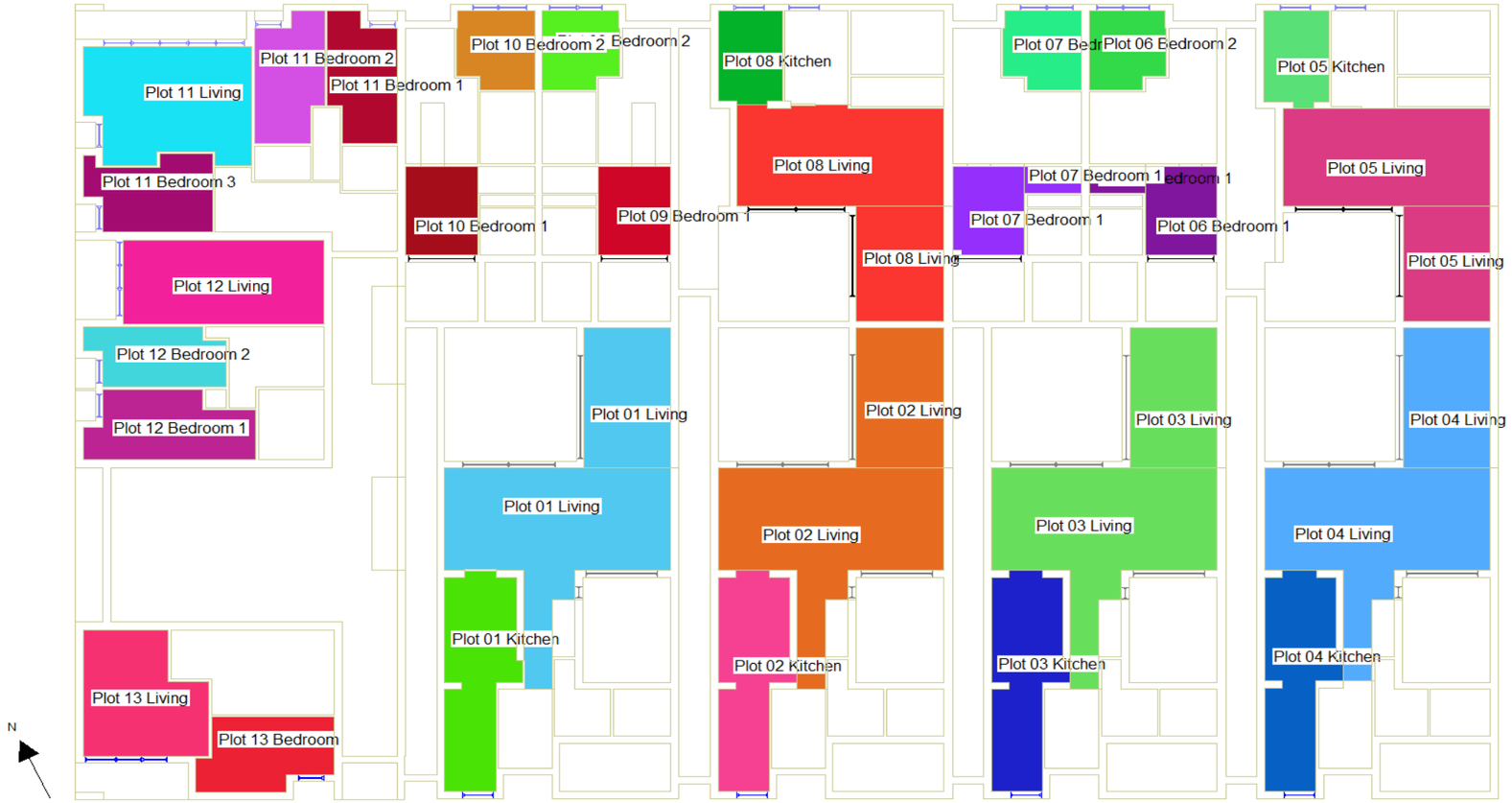


Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Annual Predicted Sunlight Hours for the Sunlighting Analysis		
Engineer:	Lorees Arakleian	**Date:**	9th December 2014
Checked By:	Martin Lawless	**Date:**	9th December 2014

RESULTS - SUMMARY

SECOND FLOOR



appendix d – solar shading plots - 21st march…

…sustainable building services solutions

appendix d…

Calculation Sheet

Project:	Mansfield Bowling Club	**Job Number:**	3369
Subject:	Solar Shading - 21st March		
Engineer:	Lorees Arakleian	**Date:**	2nd December 2014
Checked By:	Martin Lawless	**Date:**	2nd December 2014

SOLAR SHADING PLOTS - 21st MARCH

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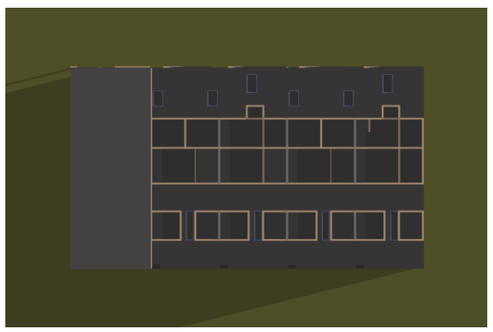

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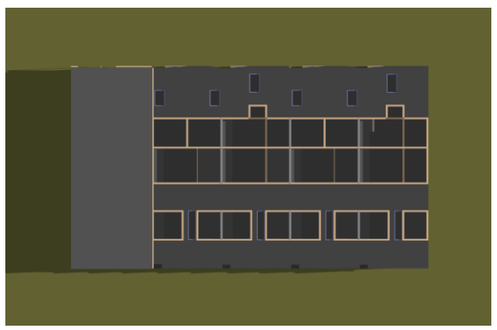

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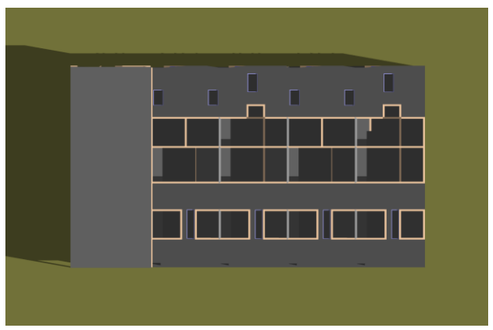

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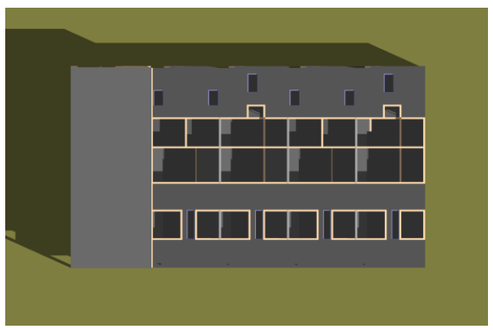

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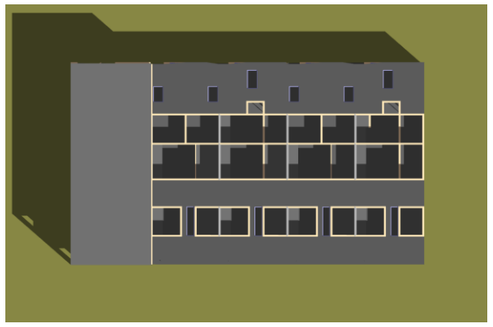

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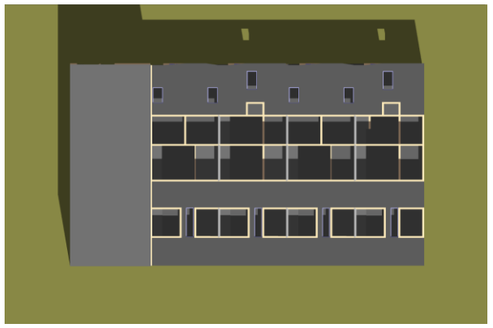

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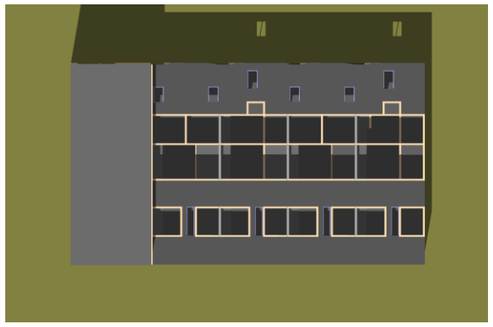

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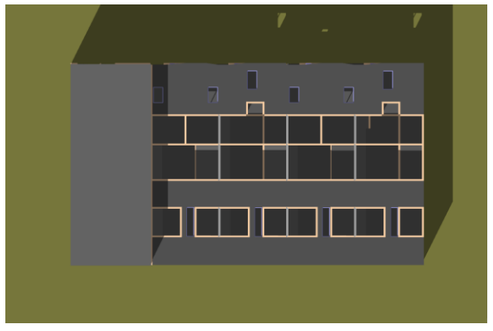

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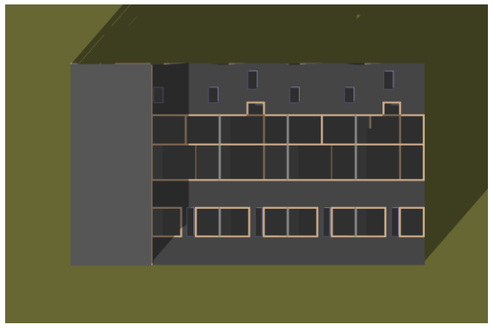

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