13.0 Micro Climate

13.1 Introduction

This Chapter comprises an assessment of the likely potential daylight, sunlight, overshadowing, light pollution and wind impacts associated with the micro climate of the proposed development of the new National Maternity Hospital at St. Vincent's University Hospital Campus in Elm Park, Dublin 4.

The proposed development comprises the redevelopment of The National Maternity Hospital at St. Vincent's University Hospital campus, Elm Park, Dublin 4. The proposed new National Maternity Hospital building will be located at the eastern side of the hospital campus and comprises the construction of a building that rises to 5 and 6 storeys above ground level, with one partial basement level, plus additional ancillary plant areas at the roof level. The proposed development also includes an extension to the existing multi-storey car park at the north of the campus. The proposed development will be constructed in a sequential manner that allows for the continual operation of the hospital campus and, as such, includes the phased demolition of existing buildings at St. Vincent's University Hospital campus to facilitate clearing the site for the proposed development and the construction of temporary accommodation to facilitate construction sequencing (including a single storey temporary canteen, catering staff changing facilities, household services store and carpenters workshop). The full detail of the nature and extent of the proposed development is set out in Chapter 2 of this EIS and the Draft Construction Management Plan is appended to same.

The daylight, sunlight, overshadowing and light pollution assessment in this Chapter has been prepared by BRE. The wind assessment in this Chapter has been prepared by RWDI, a specialist wind engineering consultancy.

13.1.1 Daylight, Sunlight and Overshadowing

This Chapter presents an evaluation of the potential impact to daylight and sunlight to properties surrounding the site of the development of the new National Maternity Hospital at St. Vincent's University Hospital Campus, and an assessment of overshadowing to their gardens. The potential for solar glare from the proposed development is also considered.

13.1.2 Light Pollution

This Chapter assesses the impact of night time spill light resulting from the development of the new National Maternity Hospital at St. Vincent's University Hospital Campus in Dublin to surrounding areas. This assessment covers baseline measurements made during a site visit by BRE on 28th October 2015, together with an estimation of the likely impact from the proposed development using computer modelling of the external lighting installation carried out by BRE based on the layout and specification provided by Arup. During the visit, the site and surroundings were inspected to determine the locations of sensitive receptors, and the existing levels of artificial light were measured at relevant locations at night. The baseline measurements of the existing light spill from the surrounding roadways and car parks and the computer modelling calculations of the proposed external lighting installations were assessed against the Institution of Lighting Professionals (ILP) guidance on obtrusive light, including upward light ratio, vertical illuminance and luminous intensity when seen from sensitive viewpoints.

13.1.3 Wind

This Chapter of the EIS also reports the findings of an assessment of the likely significant effects on the local wind micro climate as a result of the proposed development of the new National Maternity Hospital at St. Vincent's University Hospital Campus in Elm Park, Dublin 4. In particular, this Chapter considers the potential impacts of wind upon pedestrian comfort and summarises the findings of a series of simulated wind flow scenarios. Occurrences of strong winds are also reported. The full results of the Computational Fluid Dynamics assessment are presented within Appendix 13.1.

This Chapter sets out the method used to assess the potential impacts; the baseline conditions currently existing at the Site and its immediate surrounds (off-site locations); and potential impacts on the wind micro climate of the proposed development when complete and occupied. Where appropriate, the mitigation measures required to prevent, reduce or offset any potential impacts are identified within the Chapter. The impact of the proposal on the environment is considered for both the construction and operational phases of the development.

13.2 Methodology

13.2.1 Daylight, Sunlight and Overshadowing

13.2.1.1 Loss of Daylight to Existing Dwellings

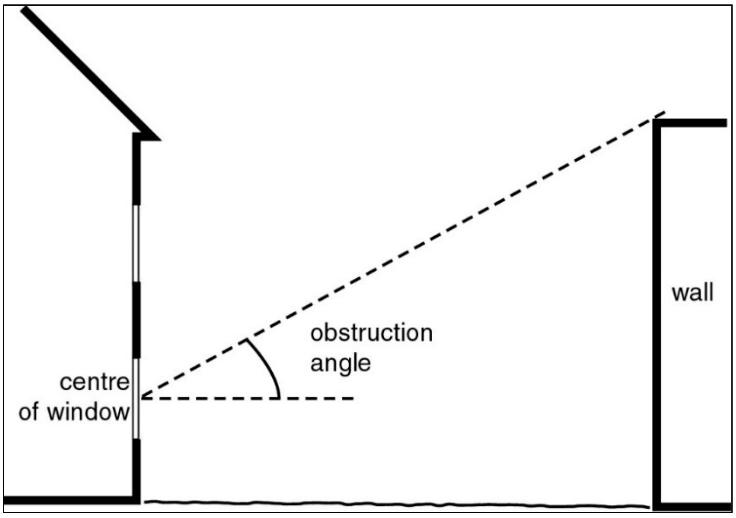
Guidance on the loss of daylight and sunlight to existing buildings and gardens following construction of new development nearby is given in the BRE Report *'Site layout planning for daylight and sunlight: a guide to good practice'*. This Report is quoted in the Dublin City Development Plan, 2016-2022 and generally is widely used by local authorities to help determine planning applications. The Department of Housing, Planning, Community and Local Government (formerly the Department of the Environment, Heritage and Local Government) in its document *'Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas'* also recommends the use of this BRE Report to assess overshadowing. The assessment has been carried out with reference to the second edition of the Report, which was published in October 2011.

The BRE Report states that loss of light to existing windows need 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 the existing window. In these cases loss of light would be small.

If the proposed development is taller or closer than this, the Report first recommends the measurement or calculation of the obstruction angle.

This is the angle to the horizontal subtended by the new development at the centre of the lowest window in each affected window wall, in a plane perpendicular to it. If this angle is less than 25° for the whole of the development, then the new building would not have a substantial effect on the diffuse skylight enjoyed by the existing building.

Figure 13.1: Obstruction Angle



The BRE Report presents a further method to assess the amount of diffuse daylight entering existing buildings, the calculation of the vertical sky component. This can be used to investigate the impact when the obstruction angle is greater than 25°. It is the ratio of the direct sky illuminance falling on the outside of a window, to the simultaneous horizontal illuminance under an unobstructed sky.

The BRE Report sets out two guidelines for vertical sky component:

a. If the vertical sky component at the centre of the existing window exceeds 27% with the new development in place, then enough sky light should still be reaching the existing window.
b. If the vertical sky component with the new development is both less than 27% and less than 0.8 times its former value, then the area lit by the window is likely to appear more gloomy, and electric lighting will be needed for more of the time.

13.2.1.2 Loss of Sunlight to Existing Dwellings

Sunlight to Windows

The BRE Report *'Site layout planning for daylight and sunlight: a guide to good practice'* states that obstruction to sunlight may become an issue if:

a. Some part of the new development is situated within 90° of due south of a main window wall of an existing building.
b. In a section drawn perpendicular to this existing window wall, the new development subtends an angle greater than 25° to the horizontal measured from the centre of the lowest window to a main living room.

If the above two conditions are met the BRE Report recommends that sunlight should be checked for all main living rooms of existing dwellings, and conservatories, if they have a window facing within 90° of due south.

The BRE Report states that if the centre of the window can receive more than one quarter of annual probable sunlight hours, including at least 5% of annual probable sunlight hours in the winter months between 21 September and 21 March, then the room should still receive enough sunlight. Any reduction in sunlight access below this level should be kept to a minimum. If the available sunlight hours are both less than the amount above and less than 0.8 times their former value, then the occupants of the existing building will notice the loss of sunlight.

Sunlight to Gardens

For outdoor amenity areas, the 2011 edition of the BRE Report *'Site layout planning for daylight and sunlight: a guide to good practice'* recommends that at least half of the space should receive at least two hours of sunlight on 21st March (spring equinox). If as a result of new development an existing garden or amenity area does not meet the above, together with a reduction in the area which can receive two hours of sun on 21st March to less than 0.8 times its former value, then the loss of sunlight is likely to be noticeable. Sunlight at an altitude of 10° or less does not count.

The BRE Report also states that where a large building is proposed which may affect a number of gardens or open spaces it is often illustrative to plot a shadow plan showing the location of shadows at different times of day. Shadow plots have therefore been produced for 9am, 10am, 11am, 12pm, 1pm, 2pm, 3pm, 4pm and 5pm Greenwich Mean Time on the 21st March (spring equinox) for the area covering the gardens to Herbert Avenue properties. It is inferred from these plots what areas of the gardens would receive two or more hours of sunlight.

13.2.1.3 Solar Glare

Glare or dazzle can occur when a heavily glazed building, or one with reflective cladding, can reflect sunlight to surrounding areas. There is no national guidance or standards covering solar glare. The BRE Report *'Site layout planning for daylight and sunlight: a guide to good practice'* gives some qualitative guidance on reflected glare. It states (paragraph 5.8.3) *'Glare to motorists approaching the building can be an issue. The worst problems occur when drivers are travelling directly towards the building, and sunlight can reflect off surfaces in the driver's direct line of sight (usually this will be off the lower parts of the building).'*

13.2.2 Light Pollution

Guidance on suitable lighting levels to limit obtrusive light is contained within four key documents:

- Institution of Lighting Professionals Guidance Notes for the Reduction of Obtrusive Light GN01:2011[1];
- National Standards Authority of Ireland IS EN 12464-2:2014[2];
- CIE Guide on the limitation of the effects of obtrusive light from outdoor lighting installations[3];
- BRE Digest 529 Obtrusive light from proposed developments[4].

There is generally good agreement between the numerical criteria on obtrusive light contained in the key documents above, except in the case of upward light, where IS EN 12464-2:2014 is less stringent than the other documents. This standard also provides recommended lighting levels for various outdoor work premises. The key documents above give various recommendations covering:

- limiting vertical illuminances on windows of neighbouring dwellings;
- limiting values for light source intensity, in a potentially obtrusive direction such as towards a house or garden;
- limits on the luminance of floodlit buildings;
- limits on upward light ratio from the installation, in order to reduce upward light that causes sky glow, making it difficult to see the stars.

The concept of a curfew is also introduced, where lighting is switched off or reduced at set times (guidance suggests between 2300 and dawn) to save energy and limit spill light when lighting is not actually needed. Different guidelines are given before and after curfew hours. The limits depend on the location of the site (for example whether it is an urban or rural site). The area of the proposed development would be classified as a 'Medium district brightness' (Class E3) corresponding to a suburban location. The recommendations for maximum spill light would then be:

- upward light ratio (fraction of light going directly to the sky) no more than 5% (Institution of Lighting Professionals and BRE) or 10% (IS EN);
- maximum illuminance at windows of 10 lux pre-curfew, and 2 lux post-curfew;
- maximum source intensity when viewed from a neighbouring house or garden of

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[1] Institution of Lighting Professionals, '*Guidance notes for the reduction of obtrusive light*', GN01:2011, ILP, Rugby, 2011.
[2] National Standards Authority of Ireland. '*Lighting of workplaces – Part 2 Outdoor work places*', IS EN 12464-2:2014, NSAI, Dublin, 2014.
[3] Commission Internationale de l'Éclairage (International Commission on Illumination; CIE), '*Guide on the limitation of the effects of obtrusive light from outdoor lighting installations*', CIE, Vienna, 2003.
[4] BRE, '*Obtrusive light from proposed developments*', Digest 529, BRE IHS Press, Bracknell, 2013.

10,000cd pre-curfew, and 1,000 cd post-curfew;

- average luminance of a floodlit building not to exceed 10 cd/m^2.

These guidelines were used as a basis for the assessment of light pollution.

13.2.3 Wind

13.2.3.1 Assessment Methodology

In order to quantify the likely effects, a Computational Fluid Dynamics analysis has been undertaken by RWDI, a specialist wind engineering company.

In this study Computational Fluid Dynamics simulations were undertaken using the Computational Fluid Dynamics code OpenFOAM. Computational Fluid Dynamics is an advanced computer modelling technique for numerically simulating wind flow in complex environments. The flow simulation was modelled using Reynolds-Averaged Navier Stokes equations, the output from which shows the average wind environment from a particular direction.

In the simulations, a simplified 3-D computer model of the proposed development was generated, capturing the overall geometry and massing of the buildings. In addition the massing of the immediate surrounding buildings was included because this will influence the wind as it approaches the Development. The simplified model of the layout and building massing was derived directly from the 3-D model provided by the architectural team. Images of the 3-D model used during the simulations are shown in Appendix 13.2.
The Computational Fluid Dynamics wind simulation were run from the following wind directions: 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° measured from north. Results from the CFD modelling were combined with RWDI's expert judgement to assess the wind environment in terms of the RWDI wind criteria.

The full technical report for the wind assessment is included as Appendix 13.1: Pedestrian Level Wind Micro Climate Assessment. The assessment has been informed by the use of:

- OS map data and architectural drawings of the existing Site and proposed development;
- Professional experience of RWDI, a specialist wind consultant;
- Relevant meteorological data for Dublin, acquired from the meteorological station at Dublin Airport;
- Computer software, BREVe3.2 which models the effect of terrain roughness around

the Site on the wind characteristics in order to adjust the meteorological data to the Site; and

- The RWDI Comfort Criteria, which defines thresholds of wind speed and frequency of occurrence for a range of pedestrian activities.

13.2.3.2 Configurations Assessed

The following configurations were assessed:

- Configuration 1: Existing Site (Baseline) with Existing Surroundings;
- Configuration 2: Proposed Development with Existing Surroundings; and
- Configuration 3: Proposed Development with Cumulative Surroundings

13.2.3.3 RWDI Wind Comfort Criteria

The RWDI pedestrian wind criteria were used in the current study. These criteria have been developed by RWDI through research and consulting practice since 1974 (References 1 through 6, as shown in Section 13.3.11). They have also been widely accepted by municipal authorities as well as by the building design and city planning community throughout the world.

The criteria set out in Table 13.1 below define a range of pedestrian activities from sitting, through to more transient activities such as crossing the road, and for each activity defines a threshold wind speed and frequency of occurrence beyond which the wind environment would be unsuitable for each activity. The criteria reflect the fact that sedentary activity, such as sitting, requires a low wind speed whereas for more transient activity such as walking pedestrians would tolerate stronger winds.

If the wind conditions exceed the threshold then the conditions are deemed to be unacceptable for the stated activity. If the wind conditions are below the threshold then they are described as tolerable or suitable for the stated activity. For example, if the wind speed exceeds 14km/h for more than 20% of the time then the conditions would be unacceptable for standing.

Table 13.1: RWDI Wind Comfort Criteria

Comfort Category	GEM Speed (km/h)	Description
Sitting	≤ 10	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away
Standing	≤ 14	Gentle breezes acceptable for main building entrances and bus stops
Strolling	≤ 17	Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park
Walking	≤ 20	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
Uncomfortable	> 20	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended
Notes: (1) Gust Equivalent Mean speed = *max* (mean speed, gust speed/1.85); and (2) Gust Equivalent Mean speeds listed above are based on a seasonal exceedance of 20% of the time between 6:00 and 23:00.		
Safety Criterion	**Gust Speed (km/h)**	**Description**
Exceeded	> 90	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.
Note: Based on an annual exceedance of 9 hours or 0.1% of the time for 24 hours a day.		

A few additional comments are provided below to further explain the wind criteria and their applications.

- Both mean and gust speeds can affect pedestrian's comfort and their combined effect is typically quantified by a Gust Equivalent Mean speed, with a gust factor of 1.85 (References 1, 5, 7 and 8; as shown in Section 13.3.11).
- Two periods (namely the 'summer season', defined as May to October, and 'winter season', defined as November to April) are adopted in the wind analysis to account for any differences in pedestrian outdoor behaviours between these two time periods.
- A 20% exceedance is used in these criteria to determine the comfort category, which suggests that wind speeds would be comfortable for the corresponding activity at least 80% of the time or four out of five days.
- Only gust winds need to be considered in the wind safety criterion. These are usually rare events, but deserve special attention in city planning and building design due to their potential safety impact on pedestrians.
- These criteria for wind forces represent 'average' wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate. Comparisons of wind speeds for different building configurations are the most objective way in assessing local pedestrian wind conditions.

13.2.3.4 Significance Criteria

The significance criteria used in the assessment of the potential impacts and the resulting likely residual impacts were based on the relationship between the desired pedestrian uses (as defined by the RWDI Comfort Criteria) in relation to the wind conditions expected at a particular location with the proposed development in place. This allows for the assessment to take into account any change in pedestrian activity that might accompany the proposed development.

A seven point scale has been utilised within this assessment, as shown in Table 13.2 and the following is an example of how the criteria have been applied: if the design wind conditions at a particular location are required to be suitable for standing, but the expected wind conditions are identified as being suitable for strolling, the difference between the desired and expected wind conditions is described as being one-step windier than desired. In this case, the potential impact would be identified as adverse, and of minor significance.

An adverse impact implies that a location has a wind environment that is windier than desired and mitigation should therefore be considered. The minor, moderate and major categories indicate the severity of the difference between the expected/reported wind micro climate and the desired wind conditions in the presence of the proposed development.

In line with RWDI methodology, strong winds are reported separately from the comfort assessment and do not form part of the significance criteria.

Table 13.2: Significance Criteria for Wind Micro Climate Assessment

Expected Wind Micro Climate	Significance of Impact
Wind Conditions are 3-steps calmer than desired	Major Beneficial
Wind Conditions are 2-steps calmer than desired	Moderate Beneficial
Wind Conditions are 1-step calmer than desired	Minor Beneficial
Wind Conditions are similar to those desired	Negligible
Wind Conditions are 1-step windier than desired	Minor Adverse
Wind Conditions are 2-steps windier than desired	Moderate Adverse
Wind Conditions are 3-steps windier than desired	Major Adverse

The changes to the massing and overall layout of the buildings on the Site substantially alter both the local wind flow and pedestrian activity within the Site. For on-site receptors, it is therefore recognised that the assessment of expected wind conditions against desired use is a more useful assessment than a direct comparison with the baseline conditions.

For off-site surrounding areas, where pedestrian activity is assumed to remain the same between the baseline and proposed development configurations, a direct comparison with the baseline conditions is more relevant and is therefore included in the discussion; however, in this case the assessment of potential effects is still primarily based on the suitability for the intended use.

13.2.3.5 Target Wind Conditions

For a hospital site, such as the proposed development (and surrounding area), the desired wind micro climate would typically need to have areas which are suitable for sitting, standing, strolling or walking.

'Uncomfortable' conditions would only be acceptable in areas that pedestrians are not generally able to access, or areas where wind comfort would not be considered an issue (such as active construction sites).

Thoroughfares

A pedestrian thoroughfare should be suitable for strolling during the windiest season. The assessment of significance for pedestrian thoroughfares focuses on the windiest season result.

Entrances

Near building entrances a wind environment suitable for standing or calmer is desired during the windiest season, because these are expected to be in use throughout the year. Should an entrance be placed near a location where strolling or walking conditions are predicted, this would be considered unsuitable for pedestrian egress and ingress and therefore would require mitigation. The assessment of significance for building entrances therefore focuses on the windiest season result.

Private Balconies, Roof Terraces and Amenity Areas

The target condition in seating areas, or other amenity spaces, is a wind micro climate that is suitable for sitting in summer months. This is because these are areas where a person might reasonably expect to sit for long periods of time. Where larger amenity areas or children's play areas are located then a mixture of sitting and standing conditions are considered acceptable, because a person can choose the more sheltered location if desired.

If an area is classified as suitable for sitting in the summer, in RWDI's experience, the stronger winds that occur during the winter season usually mean that the area would be classified as suitable for standing at this time of year, unless additional shelter was provided.

Drop–off Area

Similarly to entrances, drop-off zones would require a wind environment suitable for standing or calmer is desired during the windiest season, because these are expected to be locations where people could stand for an extended period of time and are in use throughout the year.

13.2.3.6 Strong Winds

The assessments undertaken also provide a notification of stronger winds, which are defined as gust speeds in excess of 90km/h for more than 9 hours per year. It is noted that these stronger winds are associated with the walking and uncomfortable classifications.

13.2.3.7 Off-Site Areas

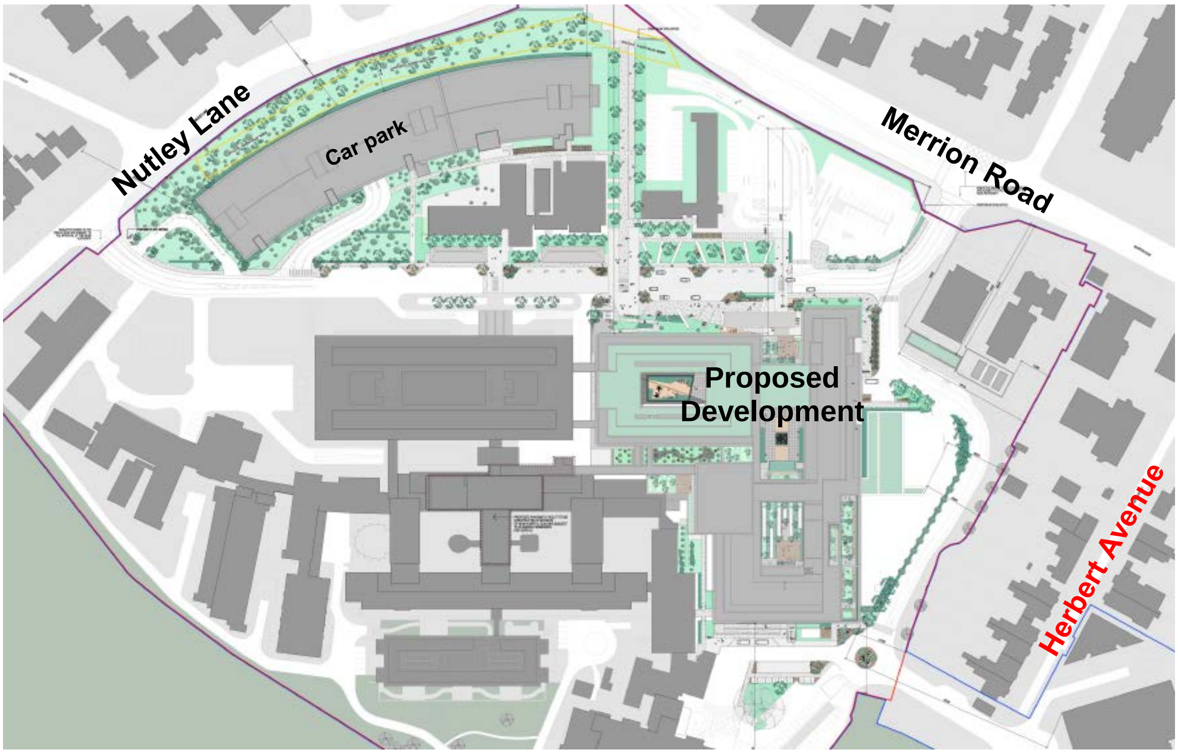
Outside the Site boundary, mitigation measures would be required in areas where the wind conditions both exceed the threshold for the intended use of the area (as described above) and have been made worse by the presence of the proposed development. In other words, an area outside the boundary of the Site that is already too windy for its intended use (according to the comfort criteria) in the baseline assessment would not necessarily require mitigation, unless it is made worse by the proposed development.

13.3 Receiving Environment

13.3.1 Daylight, Sunlight and Overshadowing

This Report assesses the impact to the nearest residential dwellings to the proposed developments on the St Vincent's University Hospital site. These are located to the east along Herbert Avenue, to the north east on Merrion Road, and to the north west on Nutley Lane. Figure 13.2 below shows the site, with the surrounding residential areas analysed labelled.

Figure 13.2: Site and Surrounding Areas



Adapted from plan by O'Connell Mahan Architects

Loss of daylight and sunlight is considered to windows at Herbert Avenue, Merrion Road and Nutley Lane. Overshadowing to the rear gardens of Herbert Avenue is also considered.

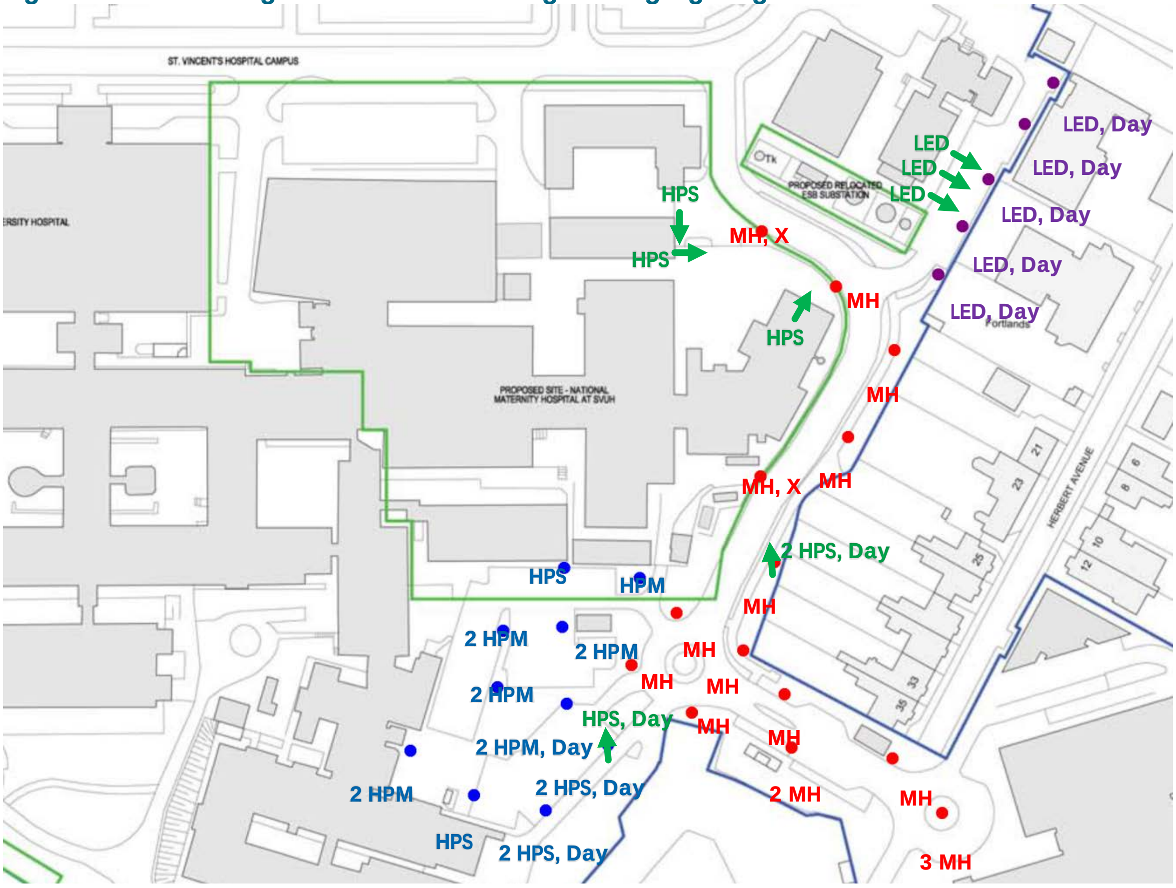
13.3.2 Light Pollution

The St Vincent's University Hospital site is surrounded by residential dwellings on almost all sides, except the Elm Park Golf and Sports Club situated to the South and South East. As observed during the site visit, the nearest residential dwellings to the proposed development on the St Vincent's University Hospital site are located to the East along Herbert Avenue. Other dwellings, such as those on Merrion Road to the North East and on Nutley Lane to the North West, are further away, and are not expected to experience significant spill light from the proposed developments. Any spill light is expected to be much less than the existing spill from street lighting in Merrion Road and Nutley Lane. Therefore spill light to dwellings on Herbert Avenue has been analysed. Figure 13.2 shows the site with the surrounding residential areas analysed labelled in red.

A visit was carried out to the site of the proposed development on 28th October 2015 to identify the locations of sensitive receptors, and to measure the existing levels of artificial light at night at relevant locations. The various findings were used to assess the baseline conditions. Measurements of illuminance and luminous intensity were taken using a calibrated illuminance meter (Lichtmesstechnik Pocket Lux 2). Luminance measurements were not needed as no floodlit building was present in the vicinity of the site. The upward light output ratio of existing luminaires cannot be measured on site, but was estimated from the luminaire type.

The current external artificial lighting consists mainly of street and car park lighting, with a number of additional floodlights attached to buildings and lighting columns. Light fittings are marked on the site layout illustrated in Figure 13.3 as follows: in red – road lighting fittings installed on 8m high grey columns, all using metal halide lamps (labelled 'MH'); in purple – road lighting fittings installed on 5.35m high green columns, all using LED lamps (labelled 'LED'); in blue – post-top fittings installed on 5.35m high green columns, using high pressure mercury lamps (labelled 'HPM') or high pressure sodium lamps (labelled 'HPS'); in green – floodlights installed on buildings or lighting columns, using LED lamps (labelled 'LED') or high pressure sodium lamps (labelled 'HPS'); arrows indicate the direction in which floodlights point. Most columns had a single fitting but some of them had more than one; the number of fittings per each column is also marked on plan. Two fittings of the first type described above (marked 'X' on plan) were not illuminated at night; this is a sign of lamp failure. Other fittings were all switched on at night. Fittings marked 'Day' were on during the day, which is a sign of a controls defect.

Figure13.3: Receiving Environment Showing Existing Lighting



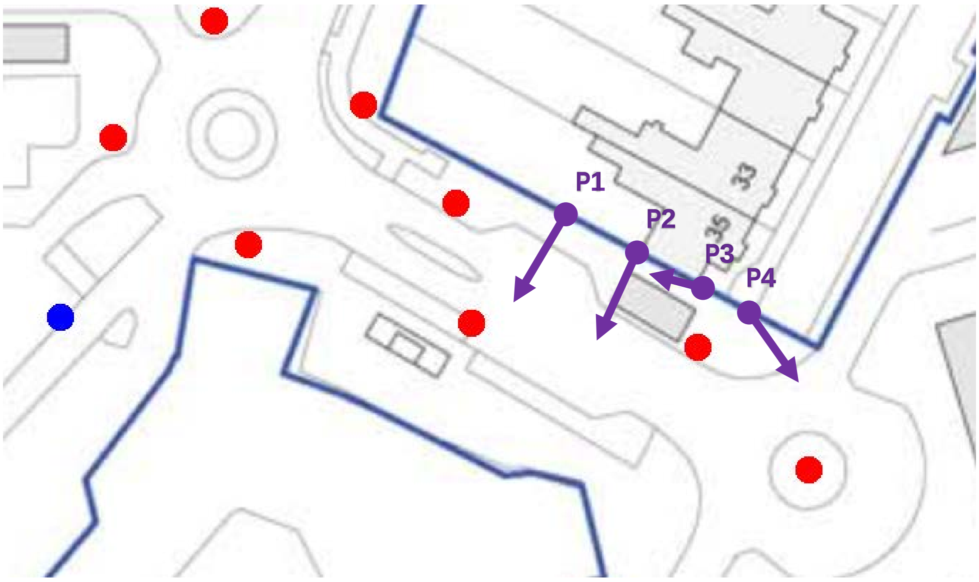
Adapted from plan by O'Connell Mahon Architects

All road lighting fittings (marked in red and purple in Figure 13.3) were identified as cut-off type, with negligible light emitted upwards. The design of the post-top fittings also appeared to limit significantly the upward light output. Floodlights were tilted downwards at angles estimated between 45° and 60° from the horizontal. A number of older road lighting fittings mounted on columns were also observed, but these were not included in the assessment as they appeared to be no longer in use. Whilst the site operates on a 24 hours a day basis, the understanding is that existing artificial lighting is kept on continuously at night, and at the same level between dusk and dawn.

The closest dwellings along Herbert Avenue had back gardens facing the proposed development. However, a line of trees was noted at the end of the back gardens along the St. Vincent's University Hospital Campus boundary. At the time of the site visit the trees were blocking any light spill from the Campus site to the dwellings. In addition, since all fittings marked in purple in Figure 13.3 were of cut-off type and no light was observed trespassing into the back gardens of the dwellings on Herbert Avenue, it was assumed that there was no light spill in this area and consequently no measurements were deemed necessary.

A relevant measurement location was identified along the side fencing at 35 Herbert Avenue. Since windows facing the proposed development could not be accessed, a number of measurement points were chosen as shown in Figure 13.4 to assess spill light from the existing lighting by measuring vertical illuminances in planes associated with window planes, and luminous intensities in the direction of the nearest and/or brightest light fittings.

Figure 13.4: Receiving Environment Showing Measurement Points and Directions for Luminous Intensity Measurements



Adapted from plan by O'Connell Mahon Architects

Several readings were taken and the average values are shown in Table 13.3.

Table 13.3: Baseline Conditions – Light Spill from Existing Lighting

Measurement point	Location	Average vertical illuminance	Average luminous intensity
P1	Along boundary by lighting column near bench	Facing side: 8.8 lux	Facing lighting column near bench (9.1m away): 704 cd
P2	Along boundary aligned with back end of house	Facing side: 6.4 lux	Facing lighting column across road (17m away): 647 cd
P3	Along boundary aligned with rear facing window	Facing rear: 3.5 lux	Facing lighting column near bench (16m away): 653 cd
P4	Along boundary aligned with side facing window	Facing side: 4.5 lux	Facing lighting column on corner (14m away): 1,250 cd

Source: site measurements

The measured illuminances range from 3.5 lux facing the rear of the garden to 8.8 lux facing the side of the garden. All the values measured are below the maximum value indicated in the guidance on suitable lighting level to limit obtrusive light during pre-curfew hours, which is 10 lux for an E3 environmental zone. Illuminances at actual window positions would be expected to be less than this, as they are all further from the lamps.

Luminous intensities from potentially obtrusive light fittings measured along the fence on St. Vincent's University Hospital Campus boundary were in the range 647 cd to 1,250 cd. The latter value may include an additional contribution from light spill coming from the private hospital site. These values are well below the maximum value indicated in the guidance on suitable lighting level to limit obtrusive light during pre-curfew hours, which is 10,000 cd for an E3 environmental zone.

The hospital is in use 24 hours a day, and therefore no curfew is applied to the external lighting as it is required throughout the night. All the measured illuminances would be above the maximum value indicated in the guidance on suitable lighting levels to limit obtrusive light during post-curfew hours, which is 2 lux for an E3 environmental zone. However, as stated above, the actual illuminances on the outside of windows could be less than the 2 lux criterion value due to the presence of trees and vegetation and to windows being farther away compared to the measurement points. Also the ILP recommendations are for guidance only, and do not have to be retrospectively applied to existing installations.

As regards luminous intensities, most of the measured values would be within guideline recommendations except for point P4 facing the roundabout at the main site entrance on Herbert Avenue, where the measured luminous intensity would be above the maximum value indicated in the guidance on suitable lighting level to limit obtrusive light during post-curfew hours, which is 1,000 cd for an E3 environmental zone. This point does not correspond to a viewing direction from a window, however.

The upward light ratios for the existing road lighting and post-top fittings were estimated to be negligible and minimal, respectively. Although the various floodlights identified were tilted at angles estimated between 45° and 60° from the horizontal, they were pointing at areas inside the St. Vincent's University Hospital Campus site, and hence spill light from these fittings to dwellings was minimal. Overall, the average upward light ratio for the whole existing lighting installation is likely to be below the maximum value indicated in the guidance to limit sky glow, which is 5% (Institution of Lighting Professionals and BRE) or 10% (IS EN) for an E3 environmental zone.

Measurement of building luminance was not applicable as there was no façade lighting in place.

13.3.3 Wind

The wind micro climate at the existing Site was assessed according to the methodology as set out at in Section 13.2.3.

Based on RWDI's assessment of the wind climate in Dublin and the results from the Computational Fluid Dynamics analysis, presently the existing Site is expected to experience a wind micro climate during the windiest season where conditions are predominantly either suitable for standing, strolling or walking for all areas.

In the summer season the wind micro climate is generally one category calmer throughout the Site and surrounding area (i.e. predominantly suitable for sitting, standing or leisurely strolling).

There are areas in the baseline configuration that are expected to experience occasional strong winds above the safety criterion (i.e. gusts exceeding 90km/h for more than 0.1% of the time annually). Windier areas are located in the north-east and south-east parts of the Site where the 'background' windiness is compounded by the acceleration of winds around the existing buildings.

Overall, the wind micro climate at the existing Site is consistent with the generally exposed nature of the Site and the relatively windy climate in Dublin. The somewhat sheltered parts of the Site that can be observed in the results are mainly located on the down-wind side (relative to the prevailing wind direction) of the existing buildings.

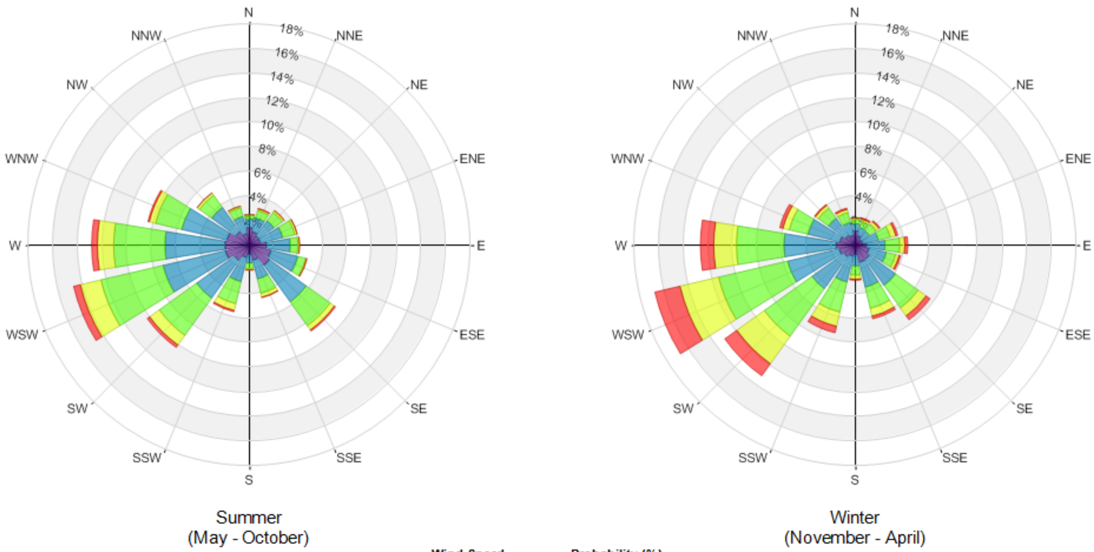
It is worth noting that the layout for the baseline assessment is dependent upon the ground floor plan of the proposed development (i.e. due to the changes to the layout of the Site, some outdoor areas in the existing Site are covered by a building or will be otherwise inaccessible in the proposed development. Such areas have been omitted from the assessment as there will be no worthwhile comparison to be made). Wind statistics recorded at Dublin Airport between 1992 and 2011 were analysed for two seasons, namely a windiest season (representing a 'worst-case' season for windy conditions between November and April) and a summer season (representing a time of the year when amenity spaces are expected to be usable between May and October).

Figure 13.5 graphically depicts the distribution of wind frequency and directionality for the two seasons.

The meteorological data obtained indicates that the prevailing wind throughout the year is from the west and southwest sectors (i.e. 210 to 270 degrees). Winds from this direction during the winter/spring seasons tend to be stronger than during the summer.

From a review of the meteorological data, it is noted that Dublin has a relatively ‘windy’ climate overall (by comparison with the wind climate in London, for example). Strong winds and storms are prevalent, which are expected to create an uncomfortable micro climate for pedestrians for part of the year even without the influence of building-induced accelerations.

Figure 13.5: Directional Distribution (%) of Winds, Dublin Airport (1973 - 2014)



Wind Speed (km/h)	Probability (%) Summer	Probability (%) Winter
Calm	2.5	1.6
1-10	22.4	16.9
11-20	38.9	31.4
21-30	27.3	29.7
31-40	7.0	13.5
>40	1.9	6.8

The meteorological data was corrected to standard conditions of 10m above open flat level country terrain. The meteorological model was then adjusted to the site conditions taking account of the terrain roughness using the BREVe3 software package which models the wind characteristics caused by changes in the terrain roughness at the stated reference height of 120m above the surface (the ‘reference height’). These terrain adjustment factors (‘mean factors’) are shown in Table 13.4.

Mean factors are dimensionless ratios of the wind speed at reference height at the Site over the wind speed at 10m height in open country terrain, which are used to convert standardised meteorological data to site-specific conditions.

Table 13.4: Site Meteorological Data Adjustment

Mean Factors at Reference Height (120m above the ground level)												
Direction (°N)	**0°**	**30°**	**60°**	**90°**	**120°**	**150°**	**180°**	**210°**	**240°**	**270°**	**300°**	**330°**
Mean Factor	**1.46**	**1.50**	**1.55**	**1.62**	**1.58**	**1.51**	**1.46**	**1.42**	**1.42**	**1.44**	**1.45**	**1.42**

13.4 Characteristics of the Proposed Development

13.4.1 Daylight, Sunlight and Overshadowing

The proposal includes the demolition of existing structures and the creation of new hospital buildings on the east of the St Vincent's University Hospital Campus site. An existing multi-storey car park is also proposed to be extended at the north west of the site. The nearest residential dwellings to the proposed developments are assessed.

Calculations are based on plans of the development of the new National Maternity Hospital at St. Vincent's University Hospital Campus by O'Connell Mahon Architects/Isherwood & Ellis Architects. These included plans 3895_NMH_OCM_A_DR_SD_110 to 118, dated 02/07/2015 and elevations 3895_SD220 to 225, dated 01/07/2015. These were used in conjunction with a topographical survey of the existing site and a BRE site visit to inspect and measure existing buildings and window positions on 28th – 29th October 2015.

13.4.2 Light Pollution

The proposed development comprises the development of the new National Maternity Hospital at St. Vincent's University Hospital campus, Elm Park, Dublin 4 as described in Section 13.1 above.

The light pollution assessment was based on the external lighting layout for the proposed development prepared by Arup, drawing number NMH-ARU-E-DR-PA-1000 rev. P2 dated May 2016. The assessment was also based on plans of the proposed development by O'Connell Mahon Architects/Isherwood & Ellis Architects. All of the above were used in conjunction with a site visit that BRE undertook on 28th October 2015 to determine the locations of sensitive receptors and the existing levels of artificial light at night at relevant locations.

The footprint of the new building is increased compared to the existing buildings on site, and will require the removal of existing external lighting in the areas where the new building is constructed. Some of the lighting to the south of the proposed new National Maternity Hospital building (principally obsolete high pressure mercury fittings) will also be replaced. The existing lighting on the top of the multi-storey car park at the north of the campus will be removed, and the new top floor of the car park will be lit by new LED lighting. Existing lighting will be retained in other areas. Additional external lighting is proposed for a number of roads, pathways and car parks (including the extension to the multi-storey car park), as well as building façades and entrances, and landscaping. The newly proposed lighting will use predominantly LED luminaires with 100% downward light output. Road lighting will use photocell control and dimming to allow for reduced illuminance levels when usage is low or late at night. Uplight accent luminaires will also be used under a number of trees but these will have low output and highly controlled beam.

13.4.3 Wind

The proposed development comprises the development of the new National Maternity Hospital at St. Vincent's University Hospital Campus, Elm Park, Dublin 4 as described in Section 13.1 above. The new National Maternity Hospital building is the aspect of the proposed development that is assessed within this Chapter.

In addition, the extension to the multi-storey car park comprises one full deck above the existing three storey car park plus one additional partial deck over the western end of the existing car park together with a new five-storey extension to the western end of the existing car park.

The full detail of the nature and extent of the proposed development is set out in Chapter 2 of this EIS and the Draft Construction Management Plan is appended to same.

13.5 Potential Impact of the Proposed Development

13.5.1 Construction Phase

13.5.1.1 Daylight, Sunlight and Overshadowing

During the construction phase there is normally an initial increase in daylight and sunlight provision to surrounding areas, as existing buildings on the site are demolished. As new buildings are constructed, daylight and sunlight provision to surrounding areas gradually decreases until the buildings reach their final size and height. It is rare for cranes and other construction equipment to block significant amounts of daylight and sunlight, and therefore the impact on daylight and sunlight during the construction phase is generally less than during the operational phase. Accordingly the analysis in this Chapter has focused on the impacts during the operational phase, since these will represent the worst case impacts.

13.5.1.2 Light Pollution

No significant changes to the existing lighting scheme are expected during the construction phase. Whilst some of the fittings may be removed, such as some of the floodlights attached to buildings to be demolished, changes in light spill to the sensitive receptors analysed are expected to be negligible.

Nevertheless, there may be a temporary increase in levels of artificial light at night on site when construction work takes place after dusk, particularly in winter. Section 13.6.1.2 gives recommendations to reduce potential impacts from construction lighting.

13.5.1.3 Wind

As impacts during the construction phase were not assessed by the Computational Fluid Dynamics analysis, professional judgment would be used instead and conclude that the overall demolition as well as wind effects of the proposed development on the local wind micro climate during the construction phase would not be materially worse at any location than either the baseline or proposed development configurations that were tested as part of the Computational Fluid Dynamics assessment. It can also be noted that during construction, there would be areas considered as a working Site in which windier conditions would be tolerated.

On a cleared Site, the potential impact with regard to wind would be that the oncoming wind would blow unimpeded across the empty Site (in other words, the lack of shelter from nearby buildings would be the main cause of any wind issues).The buildings under construction would progressively change the wind conditions from the existing situation to the final, 'operational' condition with the final condition would be expected to represent the worst-case for the proposed development.

13.5.2 Operational Phase

13.5.2.1 Daylight, Sunlight and Overshadowing

The potential for the constructed proposed development to impact daylight and sunlight provision is assessed with regard to sensitive receptors in the receiving environment. Loss of daylight and sunlight is considered to windows at Herbert Avenue, Merrion Road and Nutley Lane. Overshadowing to the rear gardens of Herbert Avenue is also considered. (For dwellings in Nutley Lane and Merrion Road the rear gardens would be unaffected by the proposed development). Solar glare has also been considered.

Loss of Daylight and Sunlight to Windows

Herbert Avenue

To the east of the proposal site lies Herbert Avenue. Rear windows to properties would have a potential view of the development. The possible loss of daylight and sunlight is initially assessed by calculating the ratio of the distance of the new development to its height difference above the centre of the window. If this ratio is 3 or more, then the loss of light meets the BRE guidelines. If the ratio is less than 3, the obstruction angle (measured from the centre of the window) needs to be calculated and compared with the BRE guideline of 25 degrees. Figure 13.6 shows the properties analysed at Herbert Avenue.

Figure 13.6: Proposed Development and Herbert Avenue Properties and Gardens*.

Adapted from plan by O'Connell Mahan Architects

*Note: Blue lines show worst case areas closest to the proposed development where windows are present. These worst case areas have been analysed.

Where windows in different parts of a dwelling or group of dwellings are at the same level, the worst case window (the nearest to the proposed development) has been assessed.

At 21 Herbert Avenue there is an extension, not shown as a building on the above plan. The blue line in Figure 13.6 by 21 Herbert Avenue shows the position of the end of this extension. The worst case window at 23 Herbert Avenue was taken as representative of the extension at 21, since it is closer to the proposed development.

Figure 13.7 shows the east façade of the proposed development, facing Herbert Avenue. The building is stepped and therefore the ratios of distance to height difference from the lowest window at existing properties have been calculated for each of the different roof levels of the proposed development. The obstruction angle is also calculated. The results are shown in Table 13.5.

Figure 13.7: East Façade of the Proposed Development with Stepped Building Sections Labelled.

Table 13.5: Ratios of Distance to Height Difference, and Obstruction Angle, for different parts of the Proposed Development as viewed from Worst Case Windows at the rear of Herbert Avenue.

Property	Ratio of distance to height difference			Obstruction Angle		
	Low section	Main section	Top section	Low section	Main section	Top section
Fortlands	5.8	3.2	3.0	27.1	32.6	31.0
19 Herbert Avenue	5.2	3.1	3.0	20.4	26.3	25.7
21/23 Herbert Avenue	4.7	3.1	3.2	18.1	23.9	23.7
25/27/29/31 Herbert Avenue	3.3	2.5	2.4	17.8	23.6	23.5
33/35 Herbert Avenue	3.2	2.3	2.3	17.3	23.2	23.0

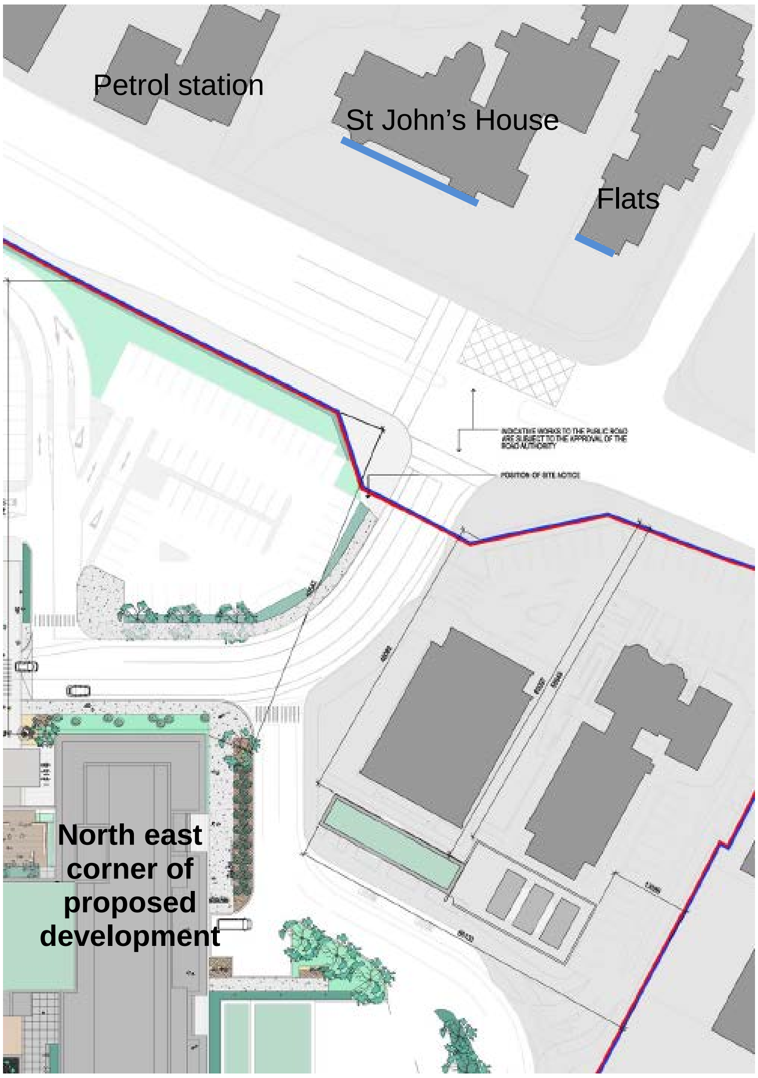
For Fortlands, 19 Herbert Avenue and 21/23 Herbert Avenue, the ratio of distance/height difference is three or more for all parts of the new development. The loss of daylight will be small and will meet the BRE guidelines. For 25-35 Herbert Avenue the ratio of distance/height difference is less than three for the main and top sections of the new development. However the obstruction angle, measured from the centre of the lowest window, will be less than 25 degrees in each case. The loss of daylight will therefore be small and will meet the BRE guidelines.

Loss of sunlight to the windows facing the new development at the rear of dwellings in Herbert Avenue is not an issue because they face north west (i.e. not within 90 degrees of due south).

Merrion Road

The two closest residential properties to the proposed development on Merrion Road are St John's House care home and neighbouring Merrion Village apartments, opposite the entrance to the St Vincent's University Hospital Campus. Their location is shown in Figure 13.8.

Figure 13.8: Nearest Residential Properties along Merrion Road to the proposal site. Blue lines show window walls where obstruction angle was calculated.



Adapted from plan by O'Connell Mahan Architects

The ratios of distance to height difference from the lowest window at existing properties have been calculated for the main and top sections of the proposed development (the low section is at the opposite end of the building, so would have no impact). The obstruction angle is also calculated. Results are shown in Table 13.6 below.

Table 13.6: Ratios of distance to height difference, and obstruction angle, for different parts of the proposed development as viewed from worst case windows along Merrion Road.

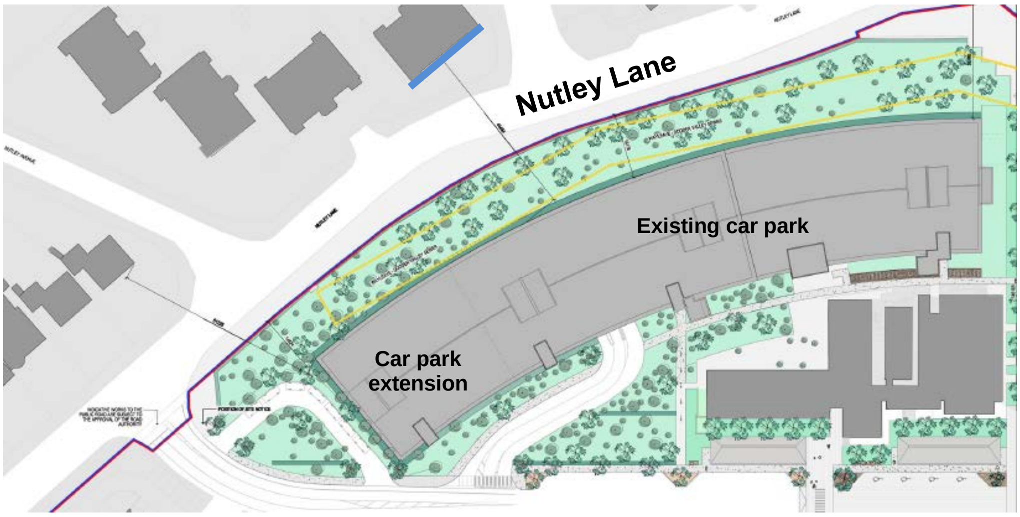
Property	Ratio of distance to height difference		Obstruction Angle	
	Main section	Top section	Main section	Top section
St John's House	3.6	3.4	15.4	16.3
Flats	3.8	3.3	15.1	16.1

The results show that properties along Merrion Road would comfortably meet the obstruction angle criteria within the BRE guidelines and therefore daylight and sunlight provision would not be significantly impacted.

Nutley Lane

Properties along Nutley Lane are a relatively long way from the proposed new National Maternity Hospital and therefore would not be impacted by the main building. However there is a proposed extension to the multi-storey car park on the hospital site opposite dwellings at Nutley Lane. As a check, the obstruction angle to the proposed car park extension is calculated for the worse case dwelling. Figure 13.9 shows the area around the proposed car park extension.

Figure 13.9: Proposed car park extension and surrounding areas. Blue lines show worst case window walls where the obstruction angle is calculated.



Adapted from plan by O'Connell Mahan Architects

The obstruction angle is calculated for the window wall of 62 – 73 Brooklands on Nutley Lane. This is a worst case area since in the plane perpendicular to the window wall this façade would be the closest to the car park extension along Nutley Lane. The ratio of distance to height difference from the lowest window at these properties has also been calculated. The results are shown in Table 13.7.

Table 13.7: Ratio of Distance to Height Difference, and Obstruction Angle, for Worst Case Windows along Nutley Lane to the Proposed Car Park Extension.

Property	Ratio of distance to height difference	Obstruction Angle
	Car park extension	Car park extension
62 – 73 Brooklands	10.4	6.5

The obstruction angle is well below 25° and therefore comfortably meets the BRE Guideline. There would be negligible impact to daylight and sunlight due to the proposed development at dwellings along Nutley Lane.

Sunlight provision to existing gardens

Overshadowing to the rear gardens of dwellings in Herbert Avenue has been considered, For dwellings in Nutley Lane and Merrion Road the rear gardens would be unaffected by the proposed development. Sunlight to the Elm Park golf course would not be affected because the proposed development would lie to the north of it.

Herbert Avenue

Shadow plots have been produced at 9am, 10am, 11am, 12pm, 1pm, 2pm, 3pm, 4pm and 5pm Greenwich Mean Time on the 21st March (spring equinox). These plots show the conditions at the mid point between the winter solstice (lowest angle sun throughout the day and therefore longest shadows) and summer solstice (highest angle sun throughout the day and therefore shortest shadows). Shadows on 21st March are equivalent to those on 21st September (autumn equinox). However in September Irish Summer Time is in force and therefore the plots correspond to an hour later under Irish Summer Time.

The BRE Report recommends that at least half of a garden area should receive at least two hours of sunlight on 21st March. The shadow plots are included in Appendix 13.3. With the new development in place, all the gardens would still meet this recommendation. The shadow plots show that the proposed building's shadow would not encroach onto the gardens at Herbert Avenue until the late afternoon. There is no extra shadowing until after

4pm, when the sun is already very low in the sky. Loss of sunlight to the gardens would therefore not be significant.

Solar Glare

The BRE Report *'Site layout planning for daylight and sunlight: a guide to good practice'* gives some qualitative guidance on reflected glare.

Disability glare occurs when a bright source creates a veiling luminance in the eye. This looks like a bright veil over the visual field, making it harder to see everything else. The veiling luminance is proportional to the illuminance at the eye due to the light source. It is also proportional to the inverse square of the angle between the glare source and the observer's line of sight. This is important; it means that glare sources off to one side, or above the observer, are less likely to cause disability glare. Usually, glare sources at more than 25 degrees to the line of sight can be discounted[5].

The proposed development would not have large areas of glazing. Window areas would be similar to those within the existing hospital and no areas of reflective cladding or mirror glass have been proposed.

The roads surrounding the building are Nutley Lane, Merrion Road and Herbert Avenue. Drivers in Nutley Lane would not have a view of the proposed hospital building as it would be behind the multi storey car park.

Drivers travelling south east down Merrion Road would have a direct view of the north façade of the proposed building, but direct sunlight could not be reflected at any time from this façade, as the glazing would reflect the north east part of the sky. For drivers travelling north west along Merrion Road, the buildings bordering this road would block the view of the proposed building until after the junction with Herbert Avenue. However by this time the new development would be off to one side, well away from the driver’s line of sight. The angle between the driver’s line of sight down Merrion Road and the line of view of the glazing would exceed the 25 degrees, beyond which solar glare can be discounted.

Finally, drivers in Herbert Avenue would have their view of the new development blocked by the hospital buildings, houses and trees lining this road. If a view of the new

[5] See D A Schreuder. ‘The visual cut off angle of vehicle windscreens’ Lighting Research and Technology, 17 (4) 192-193, 1985.

development was possible, it would be well off to one side, more than 25 degrees from the driver's line of sight.

Accordingly it is concluded that solar glare from the proposed development would be negligible.

13.5.2.2 Light Pollution

The potential for light pollution from the constructed proposed development is assessed with regard to sensitive receptors in the receiving environment. Therefore light spill is considered to dwellings on Herbert Avenue. Other dwellings, such as those on Merrion Road and Nutley Lane, are further away and are separated by well-lit roads, and are expected to remain unaffected by the constructed proposed development.

Computer modelling and calculations using Dialux lighting design software were carried out to assess the lighting design for the proposed development against the ILP guidance on obtrusive light, including upward light ratio, illuminance on windows of nearby dwellings (where relevant) and luminous intensity when seen from sensitive viewpoints. The design for the external lighting was checked to ensure that it meets all these guidelines.

The computer model was based on the external lighting layout for the proposed development prepared by Arup. External lighting luminaires were chosen for each of luminaire types A to G shown on the layout based on the specification provided by Arup. These are shown in Table 13.8.

Vertical illuminance and luminous intensity were calculated for multiple calculation points chosen so that they coincide with centres of windows of nearby dwellings facing the site in north-west and south-west directions; these points are marked 1-20 in Figure 13.10.

Similar calculations were performed for the measurement points P1 to P4 described in section 13.3.2 in order to assess the cumulative contribution from the proposed lighting to that of the existing lighting as measured on site.

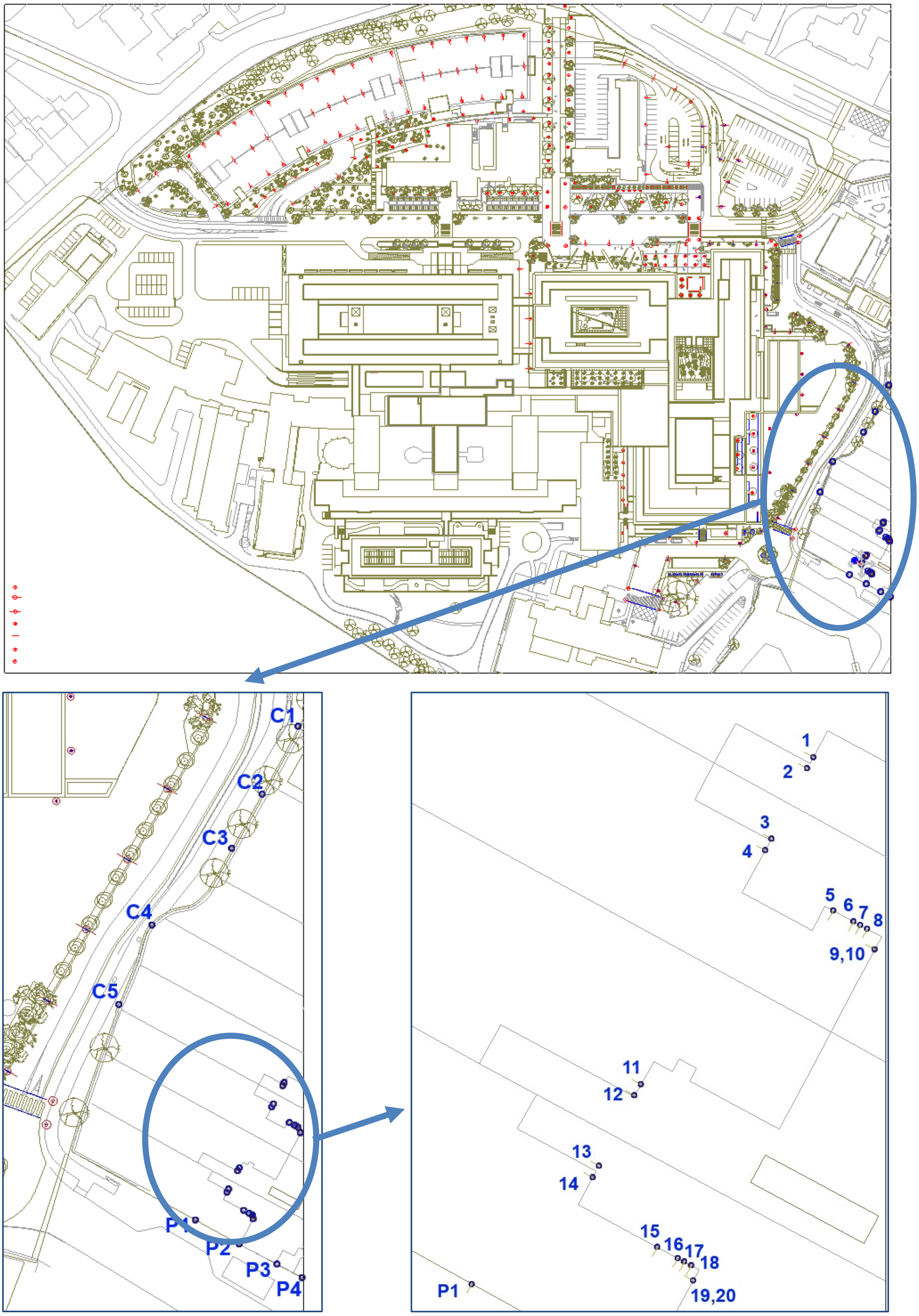
Additional control points were used in the computer model to assess the impact of the proposed lighting along the boundary of the back gardens of nearby dwellings; these points are marked C1 to C5 in Figure 13.10.

Table 13.9 gives the calculation results for vertical illuminance and maximum luminous intensity of external light fittings when seen from the calculation points shown in Figure 13.10.

Table 13.8: Luminaires used in the computer model for types A to G shown on external lighting layout by Arup.

Luminaire type	Description	Mounting height	Image	Link to product datasheet
A	LED uplight	Ground recessed		https://www.bega.de/en/products/drive-over-in-ground-luminaires-77055/ Product code 77055
B	Single head street lighting LED luminaire	6m		https://www.bega.de/en/products/light-building-elements-88977/ Product code 88977
C	Double head street lighting LED luminaire	6m		https://www.bega.de/en/products/light-building-elements-88977/ Product code 88978
D	Wall mounted area lighting LED luminaire	4m		https://www.bega.de/en/products/wall-luminaires-44481/ Product code 44481
E	Linear LED luminaire	0.4m		http://www.lucelight.it/en/prodotto.php/1351 Product code RW2010_F
F	Single head bollard luminaire	1.2m		http://www.supermodular.com/en/products/portfolio/ Product code Portfolio 0.2 IP54 LED
G	Single head bollard luminaire	2.2m		http://www.supermodular.com/en/products/portfolio/ Product code Portfolio 0.2 IP54 LED

Figure 13.10: Calculation points used in the computer calculation of vertical illuminance and luminous intensity from the proposed external lighting installation.



Adapted from external lighting layout for the proposed development by Arup

Table 13.9: Calculation results for vertical illuminance and luminous intensity from the proposed external lighting installation.

Calculation point	Vertical illuminance (lux)	Maximum luminous intensity (cd/m²)
1	0.20	15
2	0.29	15
3	0.32	16
4	0.21	16
5	0.06	17
6	0.09	17
7	0.06	17
8	0.09	17
9	0.31	17
10	0.17	17
11	0.25	18
12	0.41	18
13	0.42	18
14	0.26	18
15	0.03	18
16	0.05	18
17	0.03	18
18	0.05	18
19	0.36	18
20	0.20	18
P1	0.03	21
P2	0.02	17
P3	0.01	17
P4	0.01	17
C1	1.04	105
C2	1.47	104
C3	1.48	104
C4	4.52	204
C5	3.22	160

The calculation results show that obtrusive light from the proposed development on windows of the existing dwellings is expected to be negligible. The highest values of vertical illuminance produced by the proposed external lighting on windows of nearby dwellings is estimated to be 0.25-0.42 lux at points 11-14, corresponding to the rear elevations of 33-35 Herbert Avenue. Given the light distribution curves of the luminaires proposed and their positions relative to the sensitive receptors, direct light from these luminaires on windows at sensitive receptors appears to be negligible and calculated luminous intensities were not above 18 cd. Therefore, it is estimated that the likely impact from external lighting at the constructed proposed development in operation will remain unchanged.

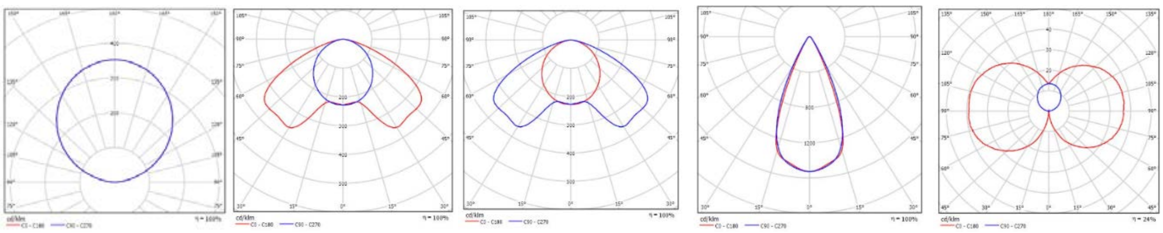
By comparing the contribution from existing street lighting, it is expected that cumulative light levels would not increase above those currently generated by street lighting. These may actually decrease if some of the existing lighting will be replaced with LED lighting having 100% downward light output.

Therefore levels of artificial light at night are expected to remain below the maximum values indicated in the guidance on suitable lighting level to limit obtrusive light during pre-curfew hours, which are 10 lux and 10,000 cd for an E3 environmental zone. Obtrusive light during post-curfew hours is expected either to be similar to the current levels, or to be reduced as new external lighting is planned to dim through the night as through route usage decreases.

Figure 13.11 shows the light distribution curves for the luminaires proposed in the external lighting layout. The proposed uplights of type A are small in number and output, and intended to use controlled beam to light trees which will restrict the amount of light reaching the sky. Although the proposed bollard luminaires of types F and G have a proportion of upward light, this is estimated to have a negligible impact given the reduced light output of these luminaires. All other luminaires of types B, C, D and E have 100% downward light output.

Figure 13.11: Light distribution curves for the proposed street lighting.

Type A ***Types B and C*** ***Type D*** ***Type E*** ***Types F and G***



Based on product datasheets from the lighting design model

Based on these diagrams, the upward light output of the proposed external lighting scheme for the entire development is estimated to be around 3.2%. This is below the maximum value indicated in the guidance to limit light going directly to the sky, which is 5% (Institution of Lighting Professionals and BRE) or 10% (IS EN). From a cumulative perspective, the upward light ratio is estimated to remain small, and probably to be reduced as all new area and street lighting is planned to emit solely downward light.

Spill light from the windows of the constructed proposed development will be negligible given the long distance to the nearest dwellings. There are not expected to be any significant additional sources of light spill from the headlights of vehicles using the site, since the proposed road layout is similar to the existing one. In particular, vehicles using the multi-storey car park would use the same access road as at present.

13.5.2.3 Wind

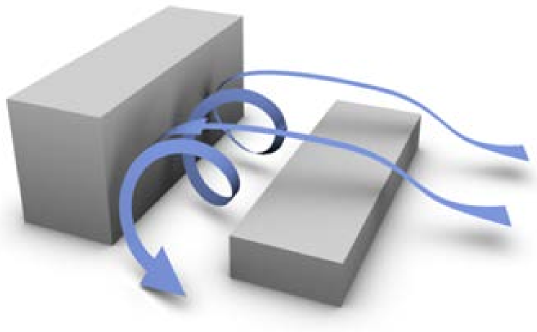
Adverse wind effects in the operational phase would result from wind conditions at an assessed location being winder than the established comfort threshold for the type of activity, as described in the methodology, in Section 13.2.3 of this Chapter. Windy conditions may result from the interaction between the oncoming wind and the buildings, which may occur in the following ways:

‘Channelling’ or ‘funnelling’

‘Channelling’ or ‘funnelling’ of the wind occurs at ground level where two or more adjacent buildings constrict the oncoming flow. The wind speeds will tend be highest at the narrowest point (i.e. the point at which the adjacent buildings are closest together). Acceleration of the flow due to this effect can be significant, especially where the gap between buildings is aligned with the prevailing wind direction.

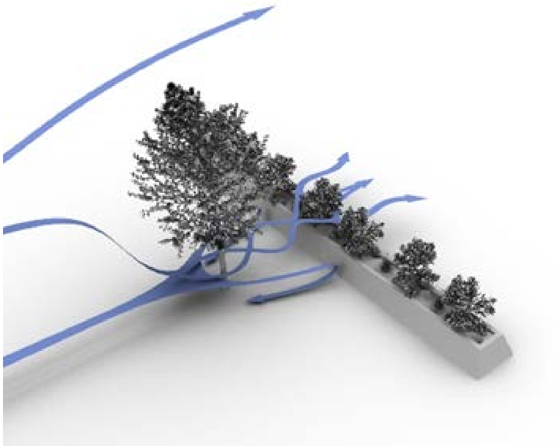
‘Recirculating’ Winds

‘Recirculating’ winds can occur where a tall building is located behind a shorter building (relative to the on-coming wind). This is similar to the down washing effect, where the wind flows against the facade of a tall building and is directed downwards to ground level. However in this case, the region of low pressure behind the shorter building causes the downwashed flow to rotate.



Landscaping

Landscaping (such as trees, hedges, or 'hard' features such as screens, trellises, pergolas, etc.) would typically provide beneficial shelter against the wind. The effect of trees or porous materials is to break-up or diffuse the wind. The effect of landscaping has not been included in the Computational Fluid Dynamics assessment (in order to provide a 'worst-case' assessment), but may form part of the mitigation strategy for areas that are deemed too windy for their intended use.



13.6 Mitigation Measures

13.6.1 Construction Phase

13.6.1.1 Daylight, Sunlight and Overshadowing

No measures required.

13.6.1.2 Light Pollution

Where construction work is carried out outside daylight hours, measures are recommended to ensure that construction lighting is placed so that light only goes where it is needed. Light fittings should be selected so that they do not cast light towards the sensitive receptors or over-light the structure to make it visually obtrusive. Lighting levels should not substantially exceed those necessary for the relevant use as recommended by IS EN 12464-2:2014[6].

Control strategies, such as centralised switching, presence detection in areas of intermittent traffic or time switches, should be used to ensure that lighting is kept on only when needed during hours of darkness.

13.6.1.3 Wind

During the construction phase, conditions will transition from the baseline conditions to conditions measured for the proposed development with existing surroundings. As this transition occurs, the only areas where increases in wind speeds are anticipated at ground level are near the north-east and south-east corners where uncomfortable conditions are expected. These effects will be temporary if remedial measures such as landscaping are incorporated during the construction process. Until such measures are implemented, it is recommended that public access to these areas is limited where possible by the use of construction hoardings.

13.6.2 Operational Phase

13.6.2.1 Daylight, Sunlight and Overshadowing

No measures required.

13.6.2.2 Light Pollution

Because of the low impact of spill light from the proposed development, including both the existing lighting that will be retained and the additional external lighting that is proposed, changes to the existing and proposed lighting would not be required for the operational phase.

However it is recommended that when installing and commissioning new lighting, the following good practice measures are maintained and implemented:

[6] National Standards Authority of Ireland. '*Lighting of workplaces – Part 2 Outdoor work places*', IS EN 12464-2:2014, NSAI, Dublin, 2014.

- Use of full cut-off luminaires to avoid upward light.
- Avoid the use of uplights with an upward lumen output above 450 lumens.
- Correct aiming of fittings to ensure that light is sent only to areas of interest.
- Aiming fittings inwards to avoid or reduce light spill out of the hospital site.
- Use of appropriate illuminance and luminance criteria for each task area.
- Consider use of dimming to allow road illuminance levels to be reduced when usage is low or late at night, subject to maintaining a safe and secure level of lighting.

13.6.2.3 Wind

The proposed development will create a micro climate that is in places calmer, the same as and in places windier conditions than the baseline conditions. Windier conditions would require mitigation measures to be implemented in order to reduce wind speeds. It should be noted that this desk study assessment has been undertaken devoid of any landscaping to represent a worst case scenario. As such, if landscaping is included then this would result in calmer conditions at the Site.

It is recommended that the suggested mitigation measures be implemented as recommended to ensure the usability of the Site for all intended pedestrian activities.

Pedestrian Comfort

Appendix 13.4 shows the windiest season results for the completed and occupied proposed development in the context of the existing surrounding buildings at ground level. Appendix 13.5 shows the summer results for the same configuration at ground level. The effects outlined in the following paragraphs are long term and significant.

Thoroughfares

As shown in Appendix 13.4, most thoroughfare areas within and around the Site would be acceptable for their intended use, having wind conditions ranging from standing to strolling during the windiest season.

Some areas along the north-east and south-east corners are expected to experience walking conditions which are one category windier than desired. These conditions could be considered acceptable if these areas aren’t on main thoroughfares or are locations where people aren’t expected to linger. Mitigation in the form of additional evergreen planting or vertical horizontal screens are recommended to improve conditions in these areas to achieve the desired strolling conditions.

Entrances

Entrance locations at ground floor level can be seen in Appendix 13.4. The main entrance is located along the north façade is largely sheltered from prevailing and secondary winds, which makes it acceptable for standing during the windiest season which represents a negligible impact.

Secondary entrance locations at ground level can also be seen in Appendix 13.4 and are expected to observe strolling conditions which represents a negligible impact. Mitigation measures in the form of recessing or implementing vertical screens on either side of the entrance is therefore recommended.

Drop-Off Area

The drop-off area located along the north façade of the proposed development is expected to observe standing conditions during the windiest season, which is acceptable for the intended use representing a negligible impact. As such, no mitigation measures are required at this location.

Amenity Spaces

Courtyard amenity spaces at ground level located within the proposed development are expected to observe sitting conditions during the summer season; which are suitable for the intended use representing a negligible impact.

The raised terrace amenity space in the west block of the proposed development is expected to observe strolling conditions during the summer season. This is two categories windier than desired and would require mitigation measures such as soft landscaping and/or 2m vertical screens to achieve the desired sitting conditions.

Safety Criterion

Occasional strong winds in excess of 90 km/h for more than 0.1% of the year are expected at south-east corner of the new National Maternity Hospital and on the upper level courtyard in the western block. These strong winds present a safety issue, and mitigation measures as described to improve comfort conditions are expected to reduce the severity of strong wind issues.

13.7 Predicted Impact of the Proposed Development

13.7.1 Construction Phase

13.7.1.1 Daylight, Sunlight and Overshadowing

Since no ameliorative, remedial or reductive measures are required, the predicted impact of the proposed development will be the same as the potential impact.

The impact on daylight and sunlight during the construction phase is generally less than during the operational phase. Therefore any loss of daylight and sunlight to windows of surrounding residential properties would be negligible. Loss of sunlight to gardens would also be negligible, and there would be negligible risk of solar glare.

13.7.1.2 Light Pollution

If ameliorative, remedial or reductive measures are implemented in accordance with the recommendations given in section 13.6.1.2, the predicted additional impact of spill light from the proposed development at construction phase would be negligible.

13.7.1.3 Wind

Predicted construction effects were not assessed by means of a Computational Fluid Dynamics analysis. Instead professional judgment was used to assess the overall demolition and construction effects of the proposed development on the local wind micro climate. It would be expected that during this temporary phase, conditions across the Site would transition from the current baseline conditions to conditions measured for the proposed development with existing surroundings. The baseline case is generally windier than the case of the proposed development with existing surroundings, and therefore is expected to represent the worst case wind environment within and around the Site. However, as construction progresses, while conditions will remain the same or become calmer at the majority of areas, a small number of areas will become one category windier, as described in the following sections.

13.7.2 Operational Phase

13.7.2.1 Daylight, Sunlight and Overshadowing

Since no ameliorative, remedial or reductive measures are required, the predicted impact of the proposed development will be the same as the potential impact.

Following construction of the new development, loss of daylight to dwellings in Herbert Avenue, Merrion Road and Nutley Lane would be small, within the BRE Guidelines. The impact is classed as negligible. Loss of sunlight to dwellings in Merrion Road and Nutley Lane would also be small and within the BRE Guidelines, and classed as negligible. Loss of sunlight to the windows facing the new development at the rear of dwellings in Herbert Avenue is not an issue because they face north west.

Loss of sunlight to gardens would be classed as a negligible impact. The proposed building's shadow would not encroach onto the gardens at Herbert Avenue until the late afternoon, and these gardens would receive ample sunlight at other times. Rear gardens of dwellings in Nutley Lane and Merrion Road would be unaffected by the proposed development. Sunlight to the Elm Park golf course would not be affected because the proposed development would lie to the north of it.

The risk of reflected solar glare from the proposed development is assessed as negligible. The proposed development would not have large areas of glazing. Window areas would be similar to those within the existing hospital and no areas of reflective cladding or mirror glass have been proposed. Drivers travelling south east on Merrion Road would not experience reflected sunlight from the proposed development, and those travelling in other directions would only view it at an oblique angle, which would not result in significant glare.

13.7.2.2 Light Pollution

Since any proposed lighting is planned to be using luminaires either with 100% downward light output or tightly controlled light beam and output, the predicted additional impact of the proposed development would be negligible; spill light could be reduced compared to the current situation.

13.7.2.3 Wind

With the proposed mitigation in place, the proposed development will create a micro climate that is typically calmer or the same as for the baseline conditions. It should be noted that, in line with typical practice in wind assessments of this type, the 3-D model was devoid of any landscaping in order to produce a relatively windy micro climate i.e. a worst-case impact scenario. With landscaping in place, conditions will be calmer than reported within this ES.

Pedestrian Comfort

Overall if the mitigation measures suggested in Section 13.6 are implemented, the required comfort conditions will be achieved throughout the proposed development.

Thoroughfares

With the proposed mitigation measures in place, all thoroughfare locations are expected to be acceptable for their intended use. This results in a negligible impact.

Entrances

With the proposed mitigation measures in place, the wind environment at all entrances is expected to be acceptable for the intended use. This results in a negligible impact.

Drop-off Area

The drop-off area located along the north façade of the proposed development is expected to observe standing conditions during the windiest season, which is suitable for the intended use. As such, no mitigation measures are required at this location. This results in a negligible impact.

Amenity Spaces

With the proposed mitigation measures in place, the courtyard amenity spaces located within the proposed development are expected to observe sitting conditions during the summer season which is acceptable for the intended use. This results in a negligible impact.

Safety Criterion

If the proposed mitigation measures recommended in Section 13.6 are implemented to improve comfort conditions, then this is also expected to reduce the severity of occasional strong wind issues.

13.7.3 'Do Nothing' Scenario

13.7.3.1 Daylight, Sunlight and Overshadowing

If the development were not constructed, daylight and sunlight provision to the surrounding area would be unchanged. However if the development were constructed on an alternative site, there could be a loss of light to the area surrounding that site.

13.7.3.2 Light Pollution

If the development were not constructed, levels of artificial light at night and light pollution in the surrounding area would remain unchanged. However if the development were to be constructed on another site, it could result in changes in obtrusive light, particularly if the site had not been previously lit.

13.7.3.3 Wind

In the event that the construction of the proposed development does not go ahead, the wind environment at the Site is expected to remain similar (at worst) to the conditions already reported in the baseline configuration. New developments in the surrounding area may change the conditions at the Site, but would typically be expected to provide additional shelter if they are taller/larger than the existing surrounding buildings.

13.7.4 'Worst Case' Scenario

13.7.4.1 Daylight, Sunlight and Overshadowing

Since no mitigation measures are required, the worst case scenario is the same as the potential impact.

13.7.4.2 Light Pollution

In the case where ameliorative, remedial or reductive measures substantially fail during the construction phase, there may be a temporary increase in levels of artificial light at night on site where some types of construction work take place after dusk, particularly in winter.

Since ameliorative, remedial or reductive measures would not be required for the operational phase, the effects arising from the proposed development would be the same as the potential impact.

13.7.4.3 Wind

The worst case scenario would be the absence of any landscaping at the site, with no mitigation implemented at the identified areas of the Site within the wind assessment; which would otherwise observe minor or major adverse impacts.

13.8 Monitoring

13.8.1 Daylight, Sunlight and Overshadowing

This is not relevant to daylight, sunlight and overshadowing. No monitoring procedures are required.

13.8.2 Light Pollution

Monitoring of artificial lighting is not considered necessary.

13.8.3 Wind

Monitoring, particularly of landscape implementation and establishment will be required to ensure that such measures provided the mitigation stated.

13.9 Reinstatement

13.9.1 Daylight, Sunlight and Overshadowing

This is not relevant to daylight, sunlight and overshadowing.

13.9.2 Light Pollution

Reinstatement measures are not required with regard to artificial lighting.

13.9.3 Wind

This is not applicable to the wind assessment.

13.10 Interactions and Potential Cumulative Impacts

13.10.1 Interactions

13.10.1.1 Daylight, Sunlight and Overshadowing

There would be no significant interactions between daylight and sunlight and other environmental impacts.

13.10.1.2 Light Pollution

Spill light from proposed developments can, in principle, have implications for the ecology of the local area. As the proposed site is already lit, the net impact on ecology is expected to be limited.

13.10.1.3 Wind

This Chapter is expected to interact directly, and should be read in conjunction with EIS Chapter 12: Air Quality & Climate.

13.10.2 Potential Cumulative Impacts

13.10.2.1 Daylight, Sunlight and Overshadowing

The assessment above has included the effect of the Private Hospital to the south east. However the Private Hospital is too far away from dwellings in Nutley Lane and Merrion Road to have a significant cumulative effect on them, and the rear windows of dwellings in Herbert Avenue (and their gardens) face away from the Private Hospital and would not be affected by it.

The redevelopment of the nursing home at St John's House would not result in a significant change. Loss of light to the redeveloped nursing home would be similar to that for the current building, and hence negligible.

Other proposed developments are too far away to have significant cumulative impacts.

13.10.2.2 Light Pollution

The baseline assessment has included the recently constructed private hospital to the South East. Of the proposed developments nearby, the redevelopment of the nursing home at St John's House would not result in a significant change. Spill light to the redeveloped nursing home would be similar to that for the current building, and hence negligible.

Other proposed developments are too far away to have significant cumulative impacts.

13.10.2.3 Wind

A further wind tunnel test was carried out to investigate the effect of consented future surrounding developments within 360m radius of the proposed development on the wind micro climate on the Site and its immediate surroundings. In general, the presence of future consented schemes results in a wind micro climate that is the same, or calmer than with the proposed development and existing surroundings. However, there are a small number of areas where conditions are windier in the presence of the cumulative surrounding buildings. These are discussed in the following paragraphs. Results are shown in Appendix 13.4 for the windiest season at ground level.

Cumulative schemes within a 360m radius of the Site were considered, as beyond this distance buildings are unlikely to have any impact on the wind micro climate around the Site.
The following development was therefore included in this assessment and has been assessed using professional judgement:

- Extension to St John's House, Dublin 4 (3704/14)

The results of the assessment have shown that there will be no additional cumulative effects as a result of the committed developments.

13.11 References

13.11.1.1 Daylight, Sunlight and Overshadowing

P J Littlefair 'Site layout planning for daylight and sunlight: a guide to good practice'. IHS BRE Press, Bracknell, 2011.

Department of the Environment, Heritage and Local Government 'Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas' Dublin, TSO, 2009.

D A Schreuder. 'The visual cut off angle of vehicle windscreens' Lighting Research and Technology, 17 (4) 192-193, 1985.

13.11.1.2 Light Pollution

BRE, 'Obtrusive light from proposed developments', Digest 529, BRE IHS Press, Bracknell, 2013.

Commission Internationale de l'Éclairage (International Commission on Illumination; CIE), 'Guide on the limitation of the effects of obtrusive light from outdoor lighting installations', CIE, Vienna, 2003.

Institution of Lighting Professionals, 'Guidance notes for the reduction of obtrusive light', GN01:2011, ILP, Rugby, 2011.

National Standards Authority of Ireland. 'Lighting of workplaces – Part 2 Outdoor work places', IS EN 12464-2:2014, NSAI, Dublin, 2014.

13.11.1.3 Wind

ASCE Task Committee on Outdoor Human Comfort (2004). Outdoor Human Comfort and Its Assessment, 68 pages, American Society of Civil Engineers, Reston, Virginia, USA.

Williams, C.J., Hunter, M.A. and Waechter, W.F. (1990). "Criteria for Assessing the Pedestrian Wind Environment," Journal of Wind Engineering and Industrial Aerodynamics, Vol.36, pp.811-815.

Williams, C.J., Soligo M.J. and Cote, J. (1992). "A Discussion of the Components for a Comprehensive Pedestrian Level Comfort Criteria," Journal of Wind Engineering and Industrial Aerodynamics, Vol.41-44, pp.2389-2390.

Soligo, M.J., Irwin, P.A., and Williams, C.J. (1993). "Pedestrian Comfort Including Wind and Thermal Effects," Third Asia-Pacific Symposium on Wind Engineering, Hong Kong.

Soligo, M.J., Irwin, P.A., Williams, C.J. and Schuyler, G.D. (1998). "A Comprehensive Assessment of Pedestrian Comfort Including Thermal Effects," Journal of Wind Engineering and Industrial Aerodynamics, Vol.77&78, pp.753-766.

Williams, C.J., Wu, H., Waechter, W.F. and Baker, H.A. (1999). "Experiences with Remedial Solutions to Control Pedestrian Wind Problems," Tenth International Conference on Wind Engineering, Copenhagen, Denmark.