EXETER
COLLEGE
OXFORD

A New Quad at Walton Street

Sustainability, Energy and Noise Statement, Including NRIA

March 2013

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CONTENTS

1.0 INTRODUCTION

This report outlines the approach taken to energy conservation and sustainability; external lighting and noise control for the proposed new accommodation building for Exeter College.

The Sustainability and Energy Strategy sections set out the requirements for sustainable building design and the associated legislative context, followed by our approach to achieving a sustainable building that complies with this legislation. This covers passive design of the building, which aims to reduce energy demand through the building design; efficient system design that aims to minimise any remaining energy requirements and also renewable energy technologies.

These sections are designed to be read alongside and compliment the Oxford City Council Natural Resource Impact Analysis (NRIA) document, which forms part of this submission.

The external lighting and noise control sections outline the proposed scheme in terms of lighting and noise; and the measures that are being taken to ensure that the development fits well with the surrounding area without causing any nuisance to the neighbours.

Alison Brooks Architects' Image of the Completed Scheme.

2.0 SUSTAINABLE DESIGN

2.1 Legislative Context

Under the Climate Change Act 2008, the Government put in place legally binding carbon reduction targets of 35% by 2020 and 80% by 2050 compared to 1990 levels.

The construction and operation of UK buildings accounts for approximately 60% of national carbon dioxide emissions. Therefore, planning legislation seeks to mitigate the impacts (in particular) of new construction in order to minimise these emissions, to meet the national targets.

Nationally, PPS1 (Planning Policy Statement 1: Delivering Sustainable Development) set out the overarching planning policies on the delivery of sustainable development through the planning system. This was effectively replaced by the National Planning Policy Framework (NPPF) which regards sustainability as an integral principle, with a "presumption in favour of" sustainable development in general, and refers to Local Plans for specific policy requirements.

2.2 National Policy: Building Regulations

Part L of the Building Regulations sets out guidelines for reducing the energy consumption of buildings. The overriding goal of the document is to ensure that reasonable provision is made for the conservation of fuel and power in buildings by limiting heat gains and losses, providing effective controls and supplying sufficient information to enable a building to be operated efficiently.

The new building is expected to be assessed under Part L2A 2010 of the Building Regulations.

2.3 Regional and Local Policy

As part of the planning process, Oxford City Council currently uses the Natural Resource Impact Analysis (NRIA), which sets out the standards and requirements for new developments in terms of energy efficiency and adaptive capacity of buildings; renewable and low-carbon energy; water consumption; and use of materials.

All new buildings with over 2000m^2 of floor area, which includes this development, must submit an NRIA and demonstrate the they are designed to optimise energy efficiency, have renewable energy schemes in appropriate locations and use recycled or reclaimed materials (Local Plan policies CP15, 16, 17 & 18). This is in line with Oxford Core Strategy Policy CS9.

The NRIA questionnaire and checklist are included as an Appendix to this report.

The Sites and Housing DPD Policy HP11 notes that the NRIA process is intended to remain in effect until October 2013, after which it will be replaced by an Energy Statement and demonstration of compliance with the 2013 Building Regulations Part L. In this report we additionally provide a brief description of the method of compliance with the 2010 Part L for this development.

3.0 ENERGY STRATEGY

3.1 Our Approach

Our approach to energy use, sustainability and environmental design for the College is focussed on making energy savings in the most cost effective and efficient manner. In order to achieve this, 'passive' measures have been applied first before considering 'active' methods.

Passive measures are generally those which use the building fabric to improve energy performance, for example (see also fig. 3.1):

- Agreeing appropriate targets for the internal environment, avoiding the need for air-conditioning where possible,
- high-performance building fabric to maximise insulation and air-tightness performance,
- incorporating solar shading to reduce solar gains and glare,
- incorporating opening areas in façade to allow natural ventilation,
- considering thermal mass in conjunction with night-time ventilation for free cooling,
- maximising daylight penetration into spaces to reduce the amount of time artificial lighting is required.

These generally have the highest CO_2 saving per pound spent and also reduce the amount, size and complexity of plant required by reducing gains and losses

Only once passive measures have been exhausted should active measures be considered. Active measures will, where possible, be applied in the following order:

1. provide low energy fittings and terminal units (e.g. light fittings, fan coil units),
2. incorporate effective and user-friendly controls,
3. provide energy efficient central plant and distribution systems including reclaim of heat where appropriate,
4. incorporate on-site renewables to meet residual loads.

Applying measures in this order ensures that internal loads are further reduced so that plant sizes can be minimised and additional costs saved (see also fig. 3.2).

The following sections illustrate how we implement this approach and give specific details of the measures taken for this project.

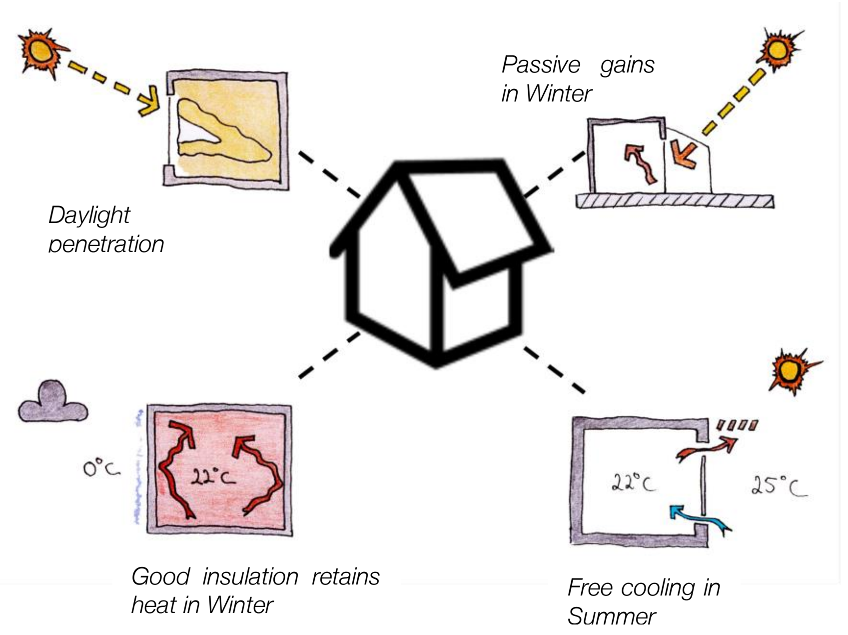

Fig. 3.1: Illustration of how passive design can perform well throughout the year

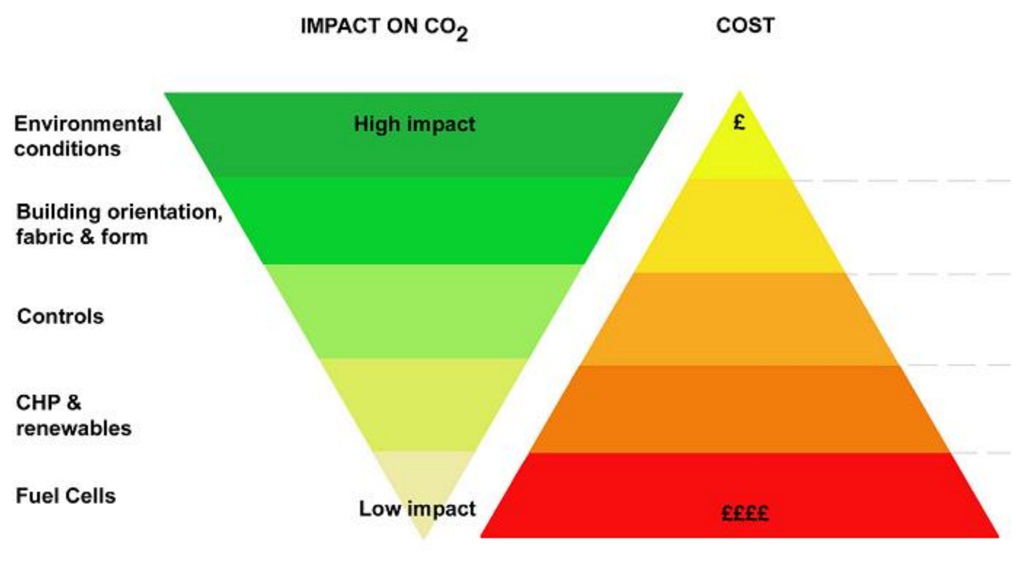

Fig.3.2: Diagram highlighting how passive over active approach achieves both lower environmental impact and higher cost savings

3.2 Using Less Energy

Building Orientation

The building is constrained within the existing retained façade elements and the available area. However, it makes the best use of the orientation by taking advantage of the south facing aspect, incorporating full-height French windows to optimise the natural lighting within the student rooms.

Daylighting and Artificial Lighting

As described above, the levels of daylighting have been maximised by incorporating large areas of glazing within the façade. A large window is provided in each of the student bedrooms to give good overall daylight within the room; and a smaller additional window is provided by the desk to provide additional daylight onto the task area.

Daylighting has been computer-modelled for a number of spaces including the student accommodation, where the model suggests a good daylight factor is available near the desks. This, in combination with local controls and daylight dimming ambient lighting controls, should reduce the requirement for artificial lighting to be switched on.

Daylight dimming will generally be incorporated in spaces with high glazing areas to make the best use of the natural light available.

General ambient artificial lighting will be provided to all areas, to a relatively low level. This will be controlled by simple manual local controls and central automatic energy-saving controls. Additional task lighting will be provided at desks and study areas. The combination of generally low light levels with localised task lighting, highly efficient LED fittings and intelligent controls will lead to an efficient lighting scheme.

Solar Control

Whilst large windows provide good natural daylight, which will reduce the energy usage in lighting, they can lead to overheating in the summer time. Therefore, solar control glass will be used for south- and west-facing glazing. The potential for overheating has been modelled in IES dynamic simulation software and is expected to be compliant with Part L of the building regulations.

Building Fabric, Insulation and Air-tightness

For a typical building, heat losses occur through the building fabric by;

- conduction (related to U-Values) and
- air leakage (related to air permeability)

These amount to approximately one third of the overall building heating load each (i.e. two thirds in total). Maximising the fabric performance is therefore very important in terms of reducing overall energy use and CO2 emissions of the building.

The Building Regulations Part L defines ‘limiting fabric parameters’ for elements of the building fabric.

The building has u-values that are an improvement on the Part L minimum standards of 40% and air tightness of 50% over the Part L 2010 limiting parameters.

Building Thermal Performance		
Glass Façade U-value:	1.4 W/m^2K	40% improvement on Part L 2010.
Solid Façade U-value:	0.25 W/m^2K	
Roof U-value:	0.15 W/m^2K	
Floor U-Value	0.15 W/m^2K	

Ventilation

The design of the internal spaces and opening windows within the façade has been optimised to maximise the usage of natural ventilation within the space. Where practical and appropriate, spaces are to be naturally ventilated.

Natural ventilation is generally achieved by the use of a combination of openable windows and permanent trickle vents. This allows for background ventilation as well as good local control.

The lecture hall will be naturally ventilated for part of the year by taking in air from the west quad through opening windows, and exhausting it at high level from rooflights. This natural ventilation will need to be mechanically assisted during periods of low internal heat gains and to assist heat recovery in winter, but for much of the time the stack effect will provide the driving force for the ventilation.

Student bedroom en-suite bathrooms require mechanical extract. This is to provide sufficient extract ventilation to comply with the building regulations. This will be provided via continuous mechanical extract, which will be controlled on a central time clock to reduce the extract rate during ‘unoccupied hours’, so reducing the energy usage of the extract system.

The system uses make-up air from the trickle vents within the rooms. A mechanical ventilation system with heat recovery (MVHR) was investigated as a low energy alternative to this. Whilst this system would reduce the building emissions slightly (by 2%), the added complexity and cost meant that this would not be economically feasible, so other low-energy and renewable technologies are adopted in preference.

In the office and teaching spaces, the internal gains are high due to the high occupancies and equipment loads. In these areas a mixed-mode system will be used.

The kitchens will use a mechanical ventilation system to provide the large air volumes required by a large kitchen. Natural ventilation of the kitchen is not practical.

The Paper Archive requires mechanical ventilation to afford the tight levels of environmental control required for conservation.

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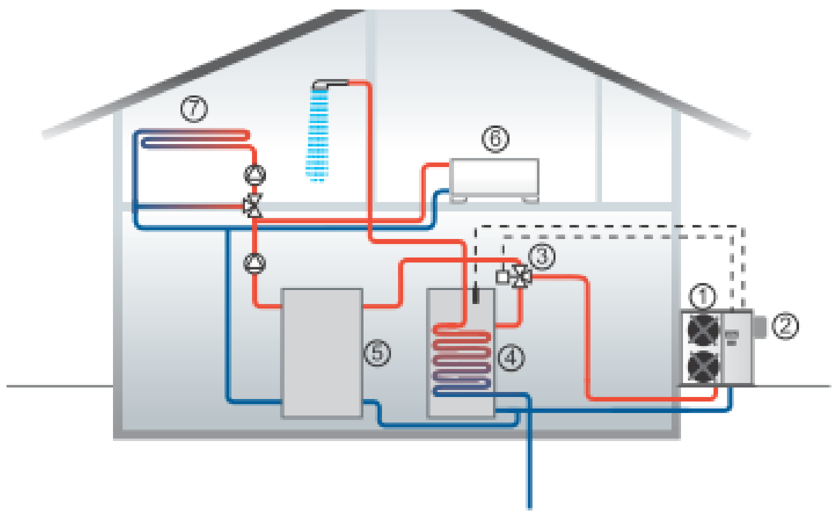
3.3 Supplying Energy Efficiently

Heat Recovery
Heat is being recovered from particular high-power ventilation systems such as the Kitchen, Offices and Lecture Hall where significant heat is available and high ventilation flowrates are required which would otherwise require very high heat input to the airflow.

Ventilation heat recovery is not being provided to the student rooms as discussed above.

The provision of a "4-pipe VRV" type heat pump system allows heat recovery from areas which may require cooling during the heating season (e.g. the Hall, Server Room or Kitchen).

We are pursuing a 4-pipe heat pump system such as the Climaveneta range (domestic schematic illustrated below):



Heating Energy Analysis
We have assessed the cost, energy and CO_2 emissions implications of using air source heat pumps vs. a conventional gas-fired boiler installation. An intermediate solution with 50% of the peak demand provided by gas was also considered.

The analysis showed that CO2 emissions for the 100% ASHP option and the 50% gas option are very similar, with a slight benefit CO2 saving available for the 50% option. Annual heating costs do not vary greatly between those options, as the gas is only used for <10% of the hours of operation per year.

A 100% gas-fired building would be marginally cheaper to run than the other options (based on current gas prices) but the non-renewable carbon emissions make demonstrating compliance with both the NRIA method and Building Regulations Part L much more difficult.

Therefore an ASHP will be used on this development to provide the majority of heating and hot water, sized to provide 50-100% of the peak heating demand.

Lighting Energy
Task lighting will be provided wherever study tasks are expected, allowing the general lighting to be reduced to a relatively low level.

Luminaires will be selected to provide good uniform and efficient light distribution.

3.4 Renewable and Low Carbon Energy Sources

Wind

Wind turbines are available in a wide range of sizes, from large 'wind-farm' scale turbines to small domestic roof-mounted versions. The output of a turbine is proportional to the area swept by the rotor, and therefore to the square of rotor diameter, so larger turbines can produce a lot more power.

The wind environment in cities is generally poor, with low average wind speeds and intense turbulence. A large-scale turbine in Oxford is expected to run at about 5% capacity factor, whereas a turbine in a commercial wind farm would be at more like 30%. Despite this, wind power is usually the most cost-effective option for generating energy on site.

The installation of wind turbines in the urban environment is still relatively novel. In addition to the high visual impact of wind turbines (people tend to either love them or hate them), there are a number of issues specific to urban sites which need to be addressed if a turbine is to be installed successfully in a city.

This, combined with the lack of available land and the sensitive acoustic nature of the project suggest that wind power would be unsuitable for this project.

<u>Verdict</u>: Not suitable for installation within the context of this project.

Biomass

A typical biomass installation includes a large storage area for the fuel, a hopper to deliver the fuel from the store to the boiler, a boiler, and a buffer vessel to take the excess heat if demand drops off when the boiler is hot and there is no demand for heat. Fuel is delivered weekly or fortnightly, and the boiler must be emptied of ash regularly. This imposes significant maintenance and logistical demands on the building operator.

The feasibility of using biomass for heating depends largely on the fuel availability. With a suitable local fuel source, biomass heating can be a cost-effective way to save significant amounts of CO_2. There are some schemes in the Oxford area (e.g. that used by the St John's College Kendrew Quad) and the suitability of these could be assessed. A more significant issue is the storage and delivery requirement. A storage area, accessible to delivery lorries, of approximately 5m x 5m x 2m high would be required for even a few weeks' storage at peak winter heating for this development.

The constrained site therefore makes biomass difficult to integrate into this project without very frequent deliveries which are likely to be undesireable to local residents.

<u>Verdict</u>: Not suitable for installation within the context of this project.

Solar (Desiccant) Cooling

Solar cooling may sound like a contradiction in terms: the principle is that the supply air is dried out and heated using a desiccant material, then the resulting hot, dry air is cooled down - using less cooling energy than is required to cool down warm, wet air. This type of cooling requires a similar amount of energy overall when compared to standard (refrigerant-based) cooling, but much of this energy is heating instead of cooling, and therefore desiccant cooling is most viable when a source of 'free' high-grade heat is available i.e. the sun.

These systems are particularly efficient in hot tropical climates, but there is some scope for their use in the UK .

The technical requirements are significant: solar thermal panels, water stores, circulation pumps, desiccant wheels, thermal wheels, heaters and water sprays for evaporative cooling. The products which combine all of these technologies into a single system are therefore complex and expensive (and still often regarded as 'innovative' in the UK). As there is not a large cooling load within this development, the complexity greatly outweighs the potential energy saving.

<u>Verdict</u>: Not suitable for installation within the context of this project.

Ground/Air Source Heat Pumps (GSHP/ASHP)
Heat pumps work by extracting heat from a low grade heat source, such as the ground or the air; and using a reversed refrigeration cycle to reject higher grade heat (in the form of warm water) to the building. They consume electrical energy but can achieve high efficiencies. When properly implemented, the use of heat pumps can result in carbon savings compared to a gas boiler. The system can also be used in reverse to provide cooling in summer.

Ground Source Heat Pumps (GSHP)

Ground source heating can achieve excellent efficiencies but involves significant capital expense, mainly because of the cost of the groundworks.

The main issue with GSHP is the location and expense of vertical boreholes or a horizontal array. There is no space on site for an effective horizontal array, and a borehole-fed system is expected to attract an initial capital cost of at least 7-10 times more than an equivalent boiler installation (even accounting for possible RHI payments).

Boreholes would be located either in the courtyard areas or beneath the building foundations. Assuming good access for drilling rigs (which is in fact not the case) then at 6m separation it may be possible to drill around 16 boreholes, which could provide around 20% of the peak heating demand for the development. GSHP is judged not to be cost-effective for this development.

Air Source Heat Pumps (ASHP)

Air source heat pumps do not require connection to the ground, however their efficiency in winter is generally lower than GSHP systems (as less heat is available from cold air than from the ground) and noise and visual planning issues become more significant.

However, in Oxford the climate is relatively mild, so number of hours that the air temperature is significantly lower than the ground is limited. Therefore air source heat pumps can achieve good seasonable efficiencies and will produce lower emissions than the equivalent boiler installation.

A heat pump combined with underfloor heating has further benefits, other than simply reducing carbon emissions:

- the lack of radiators frees up wall space, making room layouts more flexible;
- the low water temperatures associated with the underfloor heating system allow any condensing gas-fired boilers, which might supplement the heat pump under peak load conditions, to run at maximum efficiency;
- the possibility exists to use the heat pump for a limited amount of comfort cooling in seminar and lecture rooms on particularly hot days.

Verdict:
- **ASHP - Proposed to be included in this project.**
- **GSHP - Not suitable for installation within the context of this project.**

Solar Thermal Hot Water

Solar thermal systems require little maintenance and have relatively low visual impact. They are generally used to heat water for domestic hot water use.

They are more efficient than PVs at converting solar energy into a useful form, and are therefore more cost-effective. This cost is also potentially offset by the Renewable Heat Incentive (RHI) subject to government decisions on the future of the scheme.

The systems require significant hot water storage in order to avoid overheating in summer and to provide useful amounts of hot water when the sun is not shining. Also, the systems do not entirely eliminate the need for backup heating, as additional heat is required in winter and for avoidance of proliferation of Legionella.

Solar thermal systems can be used in combination with either high-temperature heat pumps or standard heat pumps with a high-temperature source such as a conventional boiler or electric immersion. This would only run to pasteurise the stored water at 65ºC for a short time, with the majority of heating being provided by the heat pump and solar panels.

There are areas of south-facing unshaded roof available in this development which face toward Worcester College gardens, partially visually shielded by trees, and would be reasonably unintrusive.

This development has a high hot water demand even in summer, which makes solar thermal cells a good match to the site's demand.

Verdict: Proposed to be included in this project.

Photovoltaics (PV cells)

PVs require little maintenance and have relatively low visual impact. They are therefore considered a safe option as a Low/Zero Carbon (LZC) technology for use in urban areas. However, compared to other LZCs they are expensive and therefore not very cost-effective (in terms of £/kWh), leading to long payback times.

Due to the limited roof area and high hot water demand of the development, PVs are not proposed for this project as the available roof area is reserved in preference for solar thermal hot water collectors.

Verdict: Not recommended for installation within the context of this project

3.5 Renewables Contribution

In order to estimate the **contribution** from the renewable provision discussed and proposed above, we must first predict of the annual energy **demand** of the building for space heating, hot water, and the other energy uses across the site (lighting, cooling, plant and general power).

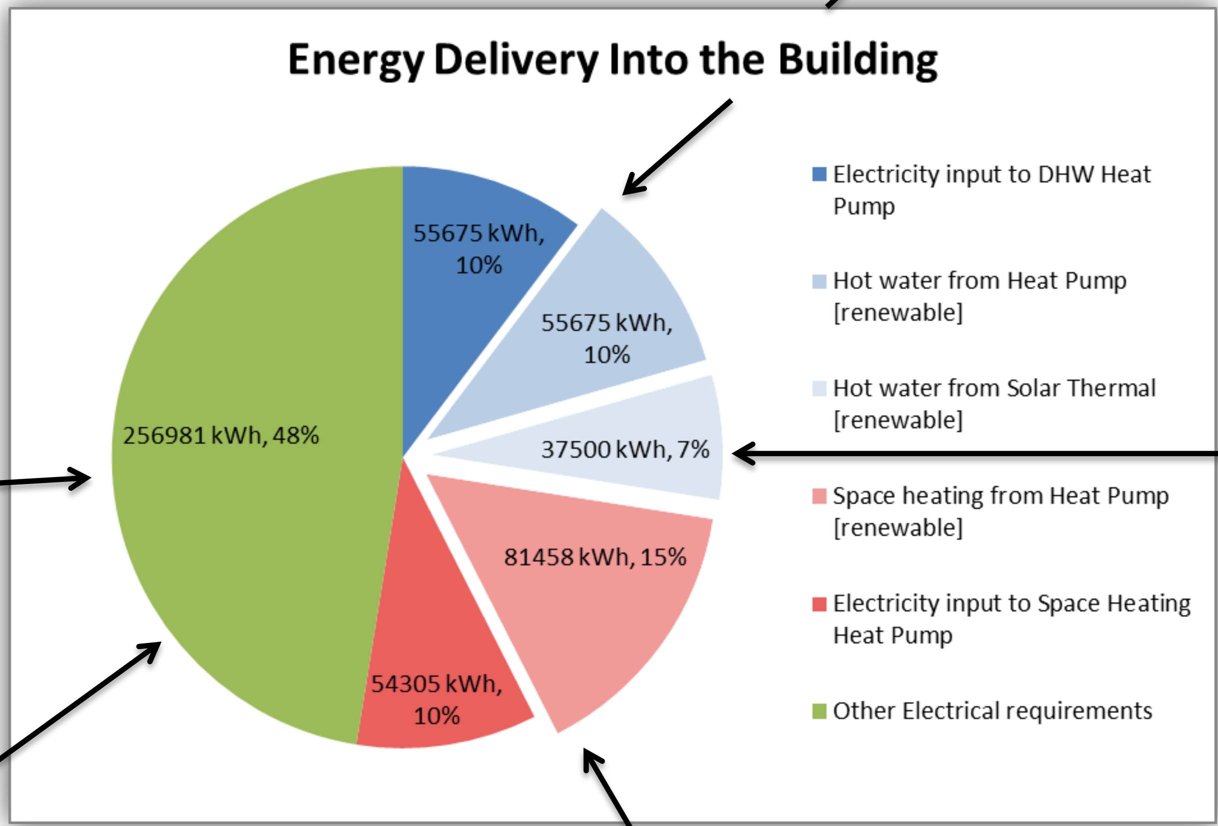
We have generated this demand prediction in three ways:

- A spreadsheet-based model which is relatively simple and provides results which are simple to interpret,
- A dynamic Part L NCM-compliant thermal simulation which models all the systems for a whole year and produces energy use figures for each system,
- Comparison with energy use benchmarks and targets across the student accommodation sector.

Although no mathematical model can predict truly accurately the way the end users will use a building, we believe our approach results in predictions which are specific to the proposed design and account but grounded in reality.

Our model predicts that 65% of the hot water and 61% of the space heating demand will be provided renewably, equating to **32% of the total annual energy demand** of the building. Refer also to the NRIA Checklist.

This is shown in the pie chart below, with the renewables contribution as the lighter, separated sections.

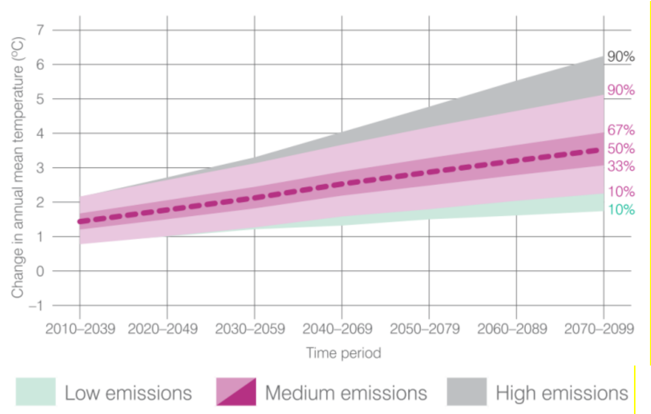


3.6 Climate Change Resilience

The Ruskin Building has been in active use for over 100 years and it is the client's wish for it to be continued to be used far into the future. Therefore the building design will be tested against the DEFRA published UKCIP 09 climate projections. These are a set of projections that can used to manipulate regional weather data to give projected sample weather years.

The chosen scenario is the "high emissions", relating to a prediction that the global emissions of CO2 will increase over the coming decades, and the probability that the climate model is an overestimate of the warming is equal to the probability that it is an underestimate. The decision to use this scenario was based upon current trends suggesting that socio-economic factors are leading to an increase in global emissions and designing on the 'worst case' climate model was not sensible given their inherent variability.

Under all modelled emission scenarios both the predicted mean temperature and peak summer temperature are observed to increase. On this basis designing to a conservative future climate will move prolong the period over which the building can be used passively. In other words, many changes that might be at the upper end of probability under a high scenario in the 2020s are projected to become the norm in, say, the 2050s.



Plot showing predicted increase in mean temperature for the South-East of England. Taken from Gething et al. 'Design for Future Climates'

A passive design approach has been discussed above and is proposed for significant proportions of this development, including natural ventilation, heavyweight building fabric, solar control glass and good natural light.

The increased peak temperatures lead to a likely increase in extreme heat waves, under these conditions it will be difficult to cool rooms with natural ventilation as even the night time temperatures may be above 25°C. The student bedrooms will be fitted with facilities for potential low energy cooling via the ASHP proposed to provide space heating. If their implementation is required cooling set points and control algorithms will be chosen so as to encourage adaptive comfort and to encourage natural ventilation cooling by opening windows when possible.

Climate variability is also expected to increase, and cold-snaps must also be addressed. The heating system will be sized to cope with extreme cold snaps while the high levels of insulation used on the project will ensure very low base heating loads.

3.7 Materials

The materials used will be specified to minimise the embodied energy and their environmental impact. This will be achieved by doing the following:

- Use of timber structure in suitable parts of the building e.g. Glazing framing / furniture.
- Use responsibly-sourced timber construction materials
- Use of recycled aggregates in construction where possible
- Local sourcing of construction materials where possible
- Selection of insulating materials with zero ozone depleting potential

The building structure is based around concrete and steel, with stone and stainless steel cladding. Timber is used where possible, but within the context of the building is not used for the primary structure on the basis of longevity and robustness.

The concrete will be specified with a high percentage of recycled aggregates and cement replacement, provided that it is possible to procure it from close enough to the site that its transportation energy does not exceed the production energy of alterative products.

Stone will be sourced locally to reduce transportation carbon.

Thermal insulation will be glass fibre with a high recycled content, reducing its embodied energy.

Where possible, materials are to be recycled on site. This includes re-using top soil to establish a temporary piling mat for the new foundations and retaining a portion of the façade (although this is done mainly for aesthetic reasons).

3.8 Waste

During the construction works, waste will be minimised and managed through the implementation of a site waste management plan. This will include the re-use of site waste where possible, as described above.

The end of life impact of the building materials has been considered in the selection of materials. However, due to the very long intended operational life of the building, the energy use in operation and maintenance are very important factors and in some cases may outweigh the need to make the materials easily recyclable.

3.9 Water

Water usage will be minimised through the use of low flow sanitaryware fittings and through the use of harvested rainwater for WC flushing and irrigation.

The sanitaryware will be specified to minimise water usage whilst maintaining comfort. This will include: low flush WCs, spray taps on wash hand basins, and low volume showers.

Rainwater will be harvested for WC flushing via underground water storage tanks located at the outflow of the building's rainwater drainage system. These storage tanks will also be used for stormwater attenuation to minimise the stormwater run-off into the public sewer.

3.10 Biodiversity and Ecology

Refer to the landscape proposals and the design and access statement for a description of the provisions relating to biodiversity and ecology. Generally there is limited scope for planting and habitat creation within the strict physical constraints of the site, however an improvement is expected over the existing situation where very little habitat is provided.

4.0 COMPLIANCE WITH PART L2

4.1 Energy Modelling

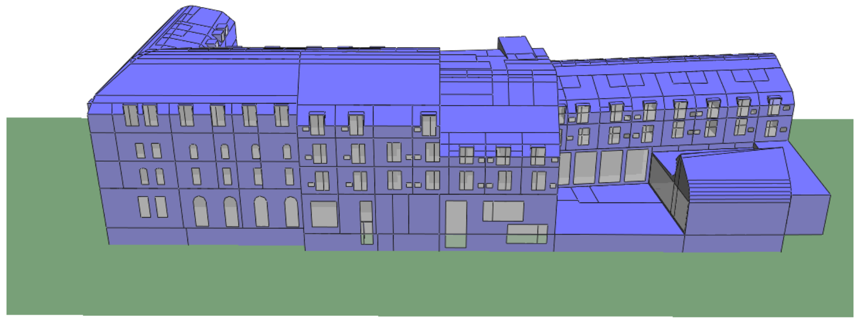
Compliance with Part L2A of the Building Regulations is demonstrated by comparing the performance of our building with a 'notional' standard building of the same shape and usage but with standard building services systems, building materials, and window design. Our building must use less energy without being susceptible to overheating, in order to pass. This requires us to make improvements over the notional building in the design such as improved insulation, more efficient systems, renewable energy generation, or better design for use of natural daylight and ventilation.

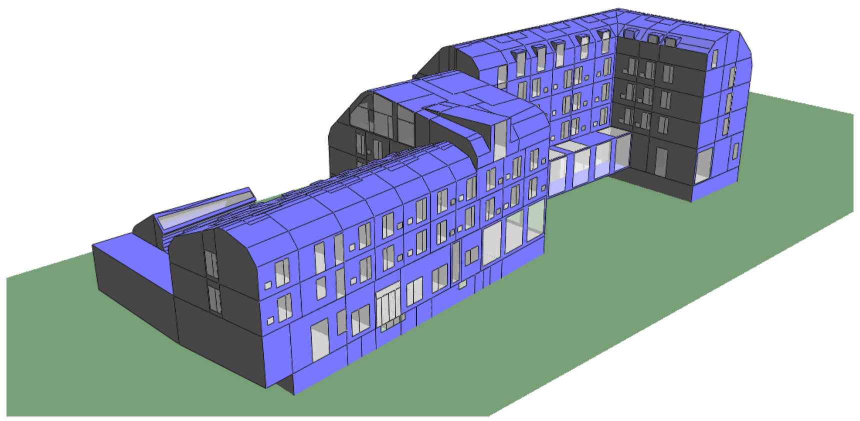
The main energy conservation features in the Walton St Quad development are:

- Solar thermal panels for hot water generation,
- Daylight and absence control on lighting,
- Some natural ventilation,
- Heat recovery on some major parts of the mechanical ventilation systems,
- Air source heat pumps (more efficient than boilers) for space heating.

The model results show that the building as currently designed should pass Part L. This is subject to re-calculation after completion based on the installation 'as-built', so that the government can confirm the design intent at the beginning of the building control application process has not been eroded.

The model geometry is as shown below:





The systems and assumptions yield the following annual energy and carbon figures, showing that our building's energy use is lower than that of the notional building.

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	11.58	19.83
Cooling	7.54	3.04
Auxiliary	1.5	0.9
Lighting	15.88	12.19
Hot water	17.54	21.46
Equipment*	36.98	36.98
TOTAL	**54.05**	**57.42**

* Energy used by equipment does not count towards the total for calculating emissions.

The associated carbon emissions (in kgCO2/m2 per year) are as shown in the BRUKL pie chart to the right. The carbon associated with hot water, heating and lighting are similar (20-30% approx each). Note that the "equipment" energy is not included in the Part L emissions calculation. Note also there is a significant amount of cooling energy shown in summer, which is a function of the modelling process and is expected to reduce in the actual building based on real-life usage.

The estimated building Energy Performance Certificate (EPC) rating is 32 - a clear 'B' – see right.

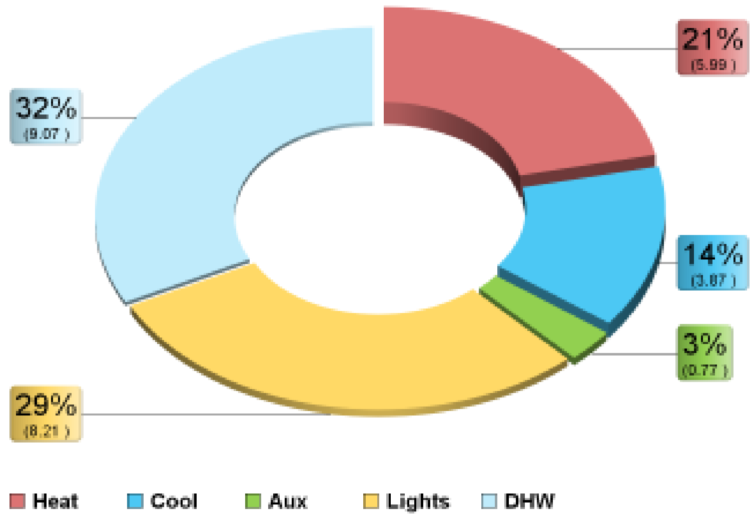
Energy consumption for the existing building on the site, for comparison is approximately 75kWh/m^2 per year for electricity, and 275kWh/m^2 per year for gas, so the proposed development is anticipated to make a significant improvement on the existing consumption of the site.

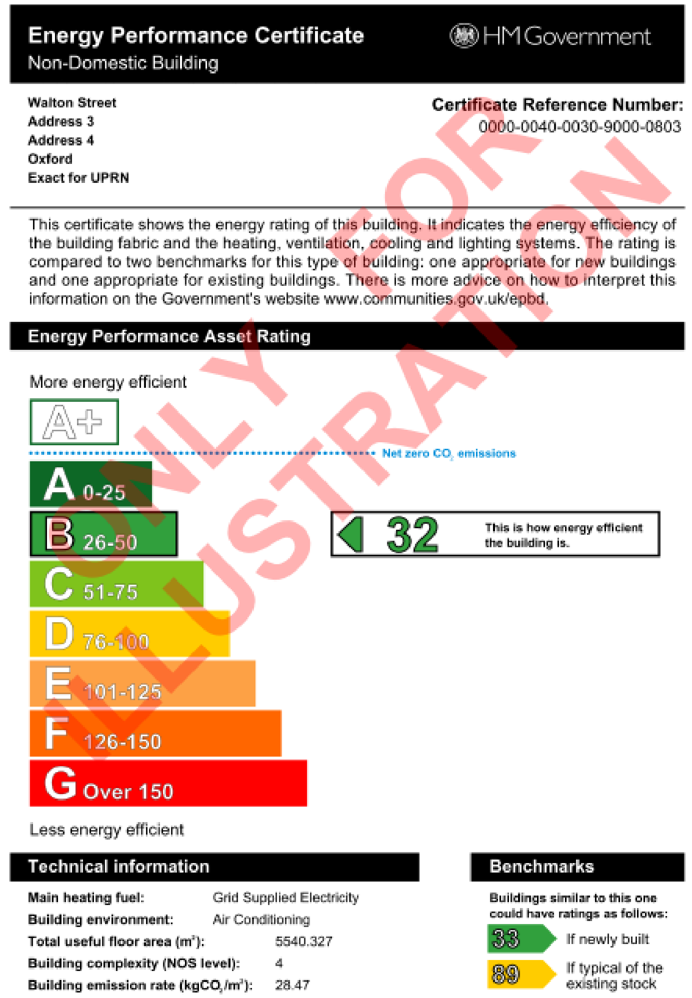
4.2 NRIA Checklist Part C1 - BER vs. TER:

For the purposes of the NRIA checklist part C1, the table below shows that this model is able to pass on CO2 emissions rate:

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

1.1	CO_2 emission rate from the notional building, kgCO_2/m^2.annum	29.7
1.2	Target CO_2 emission rate (TER), kgCO_2/m^2.annum	29.7
1.3	Building CO_2 emission rate (BER), kgCO_2/m^2.annum	27.9
1.4	Are emissions from the building less than or equal to the target?	BER =< TER





Energy Performance Certificate — HM Government
Non-Domestic Building

Walton Street
Address 3
Address 4
Oxford
Exact for UPRN

Certificate Reference Number:
0000-0040-0030-9000-0803

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Asset Rating

More energy efficient

A+

Net zero CO_2 emissions

A 0-25

B 26-50

C 51-75

D 76-100

E 101-125

F 126-150

G Over 150

Less energy efficient

32 This is how energy efficient the building is.

ONLY FOR ILLUSTRATION

Technical information

Main heating fuel:	Grid Supplied Electricity
Building environment:	Air Conditioning
Total useful floor area (m^2):	5540.327
Building complexity (NOS level):	4
Building emission rate (kgCO_2/m^2):	28.47

Benchmarks

Buildings similar to this one could have ratings as follows:

33 If newly built

89 If typical of the existing stock

5.0 EXTERNAL LIGHTING

5.1 Planning Policy and Guidance

Planning Policy
The overriding principle is that of avoiding pollution, of which light pollution forms a part. PPS23 described the government's national policy on control of light pollution and is now effectively superceded by the NPPF para 125, with detailed guidance devolved to local authorities.

Oxford City Council's Local Plan policies 9, 12, 20 and HE.11 require consideration of both safety and visual environment in new developments, ensuring that outdoor spaces are usable, safe and pleasant.

Policy CP.20 states that Planning Permission will not be granted for any development which would result in unacceptable levels of pollution and light spillage.

5.2 Need for Outdoor Lighting

External lighting is required to achieve the following:

- Provide safe routes of access through the external spaces within and around the building
- Hightlight entranceways and prevent dark corners for personal safety.
- Provide accent lighting to the historic façade and to highlight certain architectural features, within the context of the surrounding environment.

5.3 Design Approach

<u>Site wide principles for lighting</u>

All the lighting in the project must be low energy and easily maintained. Light pollution will be strictly limited and will follow the guidelines set out in tables 3 & 7 of the Society of Light and Lighting:, Guide to limiting obtrusive light – replicated in figures 5.2 & 5.3.

We propose to use primarily metal halide and LED lighting, integrated into the architecture wherever possible.

Where we do need to focus attention we will use subtle coloured lighting rather than high light levels.

<u>Routes</u>

To avoid unnecessary or wasteful lighting, routes will be picked out with directed fittings at low level.

<u>Zones and Spaces</u>

The landscaping of the quads and walkways is to provide way finding lighting and to be complemented with architectural fittings. Trees, planters and walk ways are to have subtle fittings that provide suitable light levels but that limit light trespass and sky glow. Many of the external spaces include level changes, and these will be carefully emphasised to maintain safety.

<u>Façade Lighting</u>

To enrich the features and character of the building's historic retained façade, high contrast lighting will be used to produce dramatic shadows and enhance the texture of the building. This will be designed to minimise light spill to the sky or adjoining spaces / buildings, by careful angling and control of absolute light levels.

<u>Security</u>

The development will be thoughtfully lit to create a safe landscape that it is easy to enjoy and to traverse. It should also be transparent to inspection and so all areas will meet a minimum light level and uniformity. In particular the lanes by the Worcester College boundary wall will need a level of lighting to discourage loitering.

Figure 5.1 Example low level lighting for terraces and quads

Table 7 Maximum average luminance for building facades in different environmental zones (Institution of Lighting Professionals, 2011)

Environmental zone	Maximum average building facade luminance (cd/m^2)
E0	0
E1	0
E2	5
E3	10
E4	25

Figure 5.1: Table 7 from SLL Guide to limiting obtrusive light

Table 3 Lighting recommendations for avoiding obtrusive light for area lighting (Institute of Lighting Professionals, 2011)

Environmental zone	Maximum upward light ratio (%)	Maximum illuminance on windows (lx)	Maximum luminaire luminous intensity (cd)
E0	0.0	0	0
E1	0.0	2	2500
E2	2.5	5	7500
E3	5.0	10	10 000
E4	15.0	25	25 000

Figure 5.2 - Table 3 from SLL Guide to limiting obtrusive light

6.0 CONTROL OF NOISE

6.1 Introduction

This Noise Statement has been prepared by Max Fordham on behalf of Exeter College Oxford to accompany the planning application for the new development on the site of the existing Ruskin Building on Walton Street. The development includes student accommodation, teaching rooms, lecture hall, social spaces and study rooms. The location of the new development is indicated in Figure 6.2.

There will be new plant equipment associated with the development. The majority of this will be located within internal plant room spaces.

This report presents the results of a 24-hour noise survey at the site and an assessment of noise impact from the proposed plant equipment.

Definitions of common acoustic terms are given in the appendix for reference.

6.2 Design Basis

National Planning Policy Framework
The National Planning Policy Framework (NPPF) states that the planning system should contribute to and enhance the natural and local environment by "preventing both new and existing development from contributing to or being put at unacceptable risk from or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability". Furthermore it states planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- Recognise that development will often create some noise and existing businesses wanted to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

Local Authority Requirements
The Oxford Local Plan 2001-2016 (November 2005) Section 2 – "Core Policies" describes the council's approach. Figure 6.1 shows the relevant extract from this document.

Impact of Existing Noise on the Development
The Local Authority Requirements refer to Planning Policy Guidance 24 (**PPG24**) which gives guidance on minimising the effect of existing noise on new noise sensitive developments. Residential rooms would be deemed noise sensitive in this regard.

PPG24 has now been superseded but the assessment procedure it describes will still be used as reference. The PPG24 assessment procedure is based on existing daytime and night-time average noise levels, which have been determined by means of an environmental noise survey (refer to Section 6.3).

Noise Impact from the Development
In the case of noise-generating developments (as opposed to noise-sensitive ones), PPG24 refers councils to BS4142, which describes a method for the assessing the impact on existing noise-sensitive locations from new sources of noise. Noise impact is assessed by comparing the noise generated by the new development relative to the existing background noise level at the nearest noise-sensitive location.

In this case, the nearest noise-sensitive locations are bedroom windows of houses on Worcester Place and Worcester College Student Accommodation (see Figure 6.2). The existing background noise level has been determined by means of an environmental noise survey (refer to Section 6.3).

2.19.6 Noise can significantly affect the environment, health and quality of life enjoyed by individuals and communities. The City Council will seek to ensure that noise sensitive developments are separated from major sources of noise. We regard residential, education and health care uses as noise sensitive developments, but may include others, depending on local circumstances and priorities. In some circumstances noise can also have an adverse impact on local wildlife and this will also be taken into consideration. In determining planning applications, the City Council will have regard to the advice in PPG 24, Planning and Noise.

POLICY CP.21 - NOISE

Planning permission will be refused for developments which will cause unacceptable noise. Particular attention will be given to noise levels:

a. close to noise-sensitive developments; and

b. in public and private amenity space, both indoor and outdoor.

The City Council will impose easily enforceable conditions to control the location, design, layout and operation of development proposals to minimise any adverse impact as a result of noise and its transmission.
Proposals for noise sensitive developments should have regard to:

c. the existing sources of noise, e.g. from roads, railways and other forms of transport; industrial and commercial developments; sporting, recreation and leisure facilities;

d. internally generated noise or associated externally generated noise; and

e. the need for appropriate sound insulation measures.

Figure 6.1: Extract from Oxford Local Plan 2001-2016 (November 2005) regarding Noise.

6.3 Noise Survey

Noise Survey Procedure
A long-term noise survey was undertaken by MFLLP between 3pm on Thursday 5th and 11pm on Sunday 8th April 2012. The long term survey was made at Location 1 (see Figure 6.2).

Additional short duration measurements were made at three further locations (Location 2, 3 and 4 in Figure 6.2) between 3pm and 4pm on Wednesday 4th April.

- Location 1: On roof of existing building. Approximately 30cm back from Worcester Place façade and 1.5m above eaves level.
- Location 2: On pavement at corner of Walton Street and Worcester Place, 1.5m above ground level. Measurement will include the effect of reflection from building façade.

- Location 3: On pavement at corner of Worcester Place and Walton Lane, 1.5m above ground level. Measurement will include the effect of reflection from building façade.
- Location 4: On pavement near Walton Street facade, 1.5m above ground level. Measurement will include the effect of reflection from building façade.

There was little or no precipitation during the survey and wind-speeds were low. A microphone windshield was used during all measurements as a precaution.

Data was logged at 10 second intervals and statistical values stored every 5 minutes. All measurements were made using a Norsonic 118 Sound Level Meter. Refer to the Appendix for further details regarding the equipment.

The nearest noise sensitive receptors shown in the figure below have been selected for analysis of noise impact based on proximity to noise generating activities in the development.

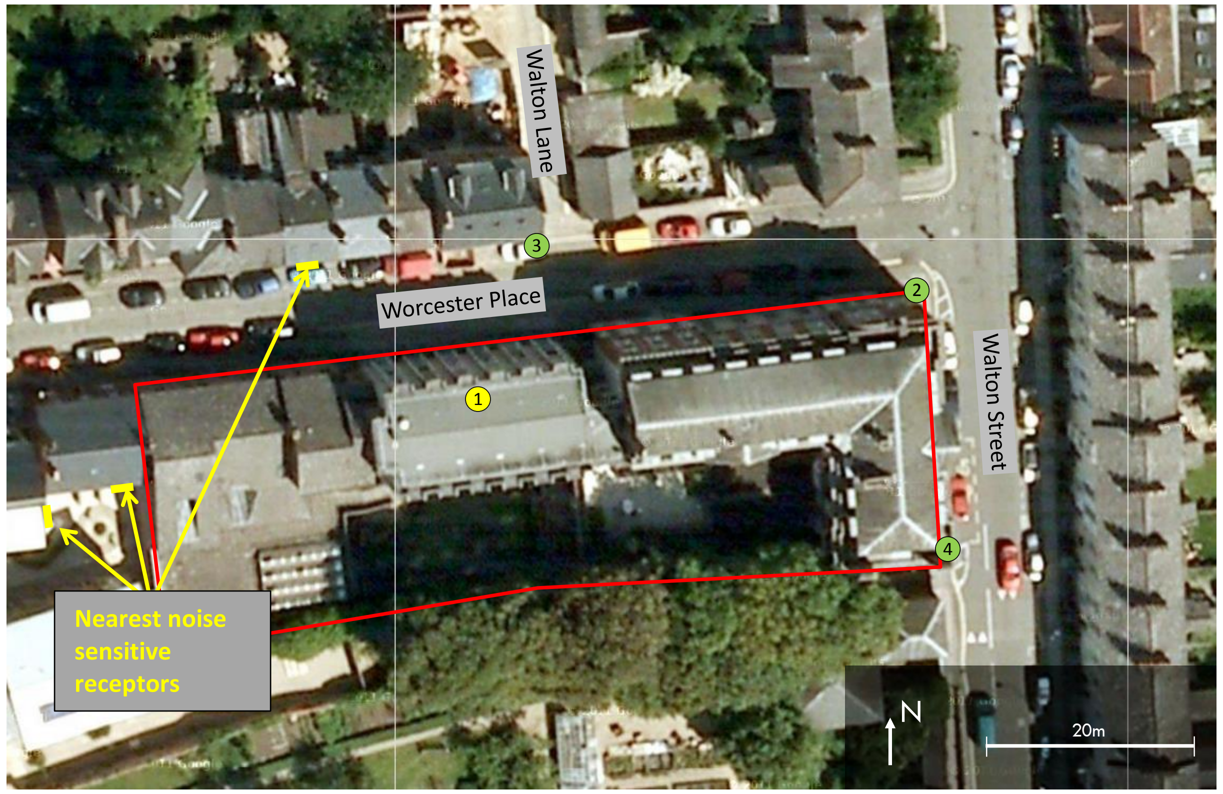


Figure 6.2: Aerial image of site showing measurement locations and the position of the nearest noise sensitive receptors.

Noise Survey Results
Figure 6.3 shows the time history of the measurements from Location 1. The graph shows the L_{Aeq}, L_{AF90} and L_{AFmax} values for each 5 minute measurement period. L_{Aeq} is the average noise level, L_{AF90} is the noise level that is exceeded for 90% of the time (i.e. a background level) and L_{AFmax} is the maximum noise level during the measurement period.

The main sources of noise are road traffic on Walton Street and general activity noise.

The average values for the full day and night periods at Location 1 are as follows:

- $L_{Aeq,day}$(16hr, 07:00-23:00) = 55.4dB. Data from Friday 6th April.
- $L_{Aeq,night}$(8hr, 23:00-07:00) = 50.5dB. Data from night of Thursday 5th April.

The lowest measured background noise levels at Location 1 were:

- Daytime (07:00-23:00): $L_{AF90,5min}$ = 47.3dB. Data from Friday 6th April.
- Night-time (23:00-07:00): $L_{AF90,5min}$ = 42.7dB. Data from night of Thursday 5th April.

The night-time $L_{AFmax,5min}$ values are under 68dB for 95% of the time

Table 6.1 shows the daytime noise levels measured at locations 1 through 4.

Location	Start Time	Duration	LAeq	LAF90	LAFmax
Location 1	15:30	5min	59.4	50.5	77.7
Location 2	15:40	5min	63.1	49.3	86.0
Location 3	15:50	5min	55.1	52	68.5
Location 4	16:00	5min	61.3	48	73.3

Table 6.1: Daytime noise measurements at locations 1 through 6.

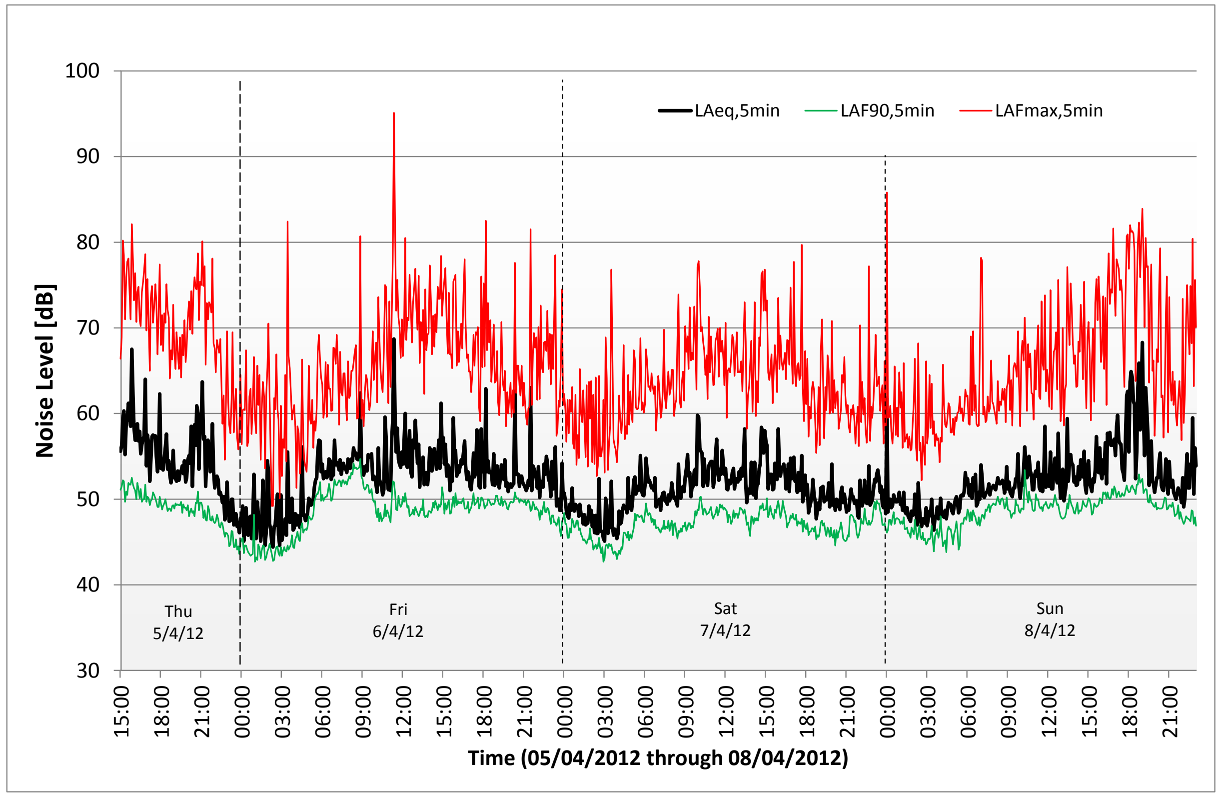


Figure 6.3: Time history of measurements at Location 1.

6.4 Noise impact

Target Level at Nearest Noise Sensitive Locations
The background noise measurements at Location 1 can be considered to be representative of those at the nearest noise sensitive locations. The nearest noise sensitive locations will be bedroom windows to houses on Walton Place and Worcester College Student Accommodation (see Figure 6.2).

The existing background noise levels at the nearest noise sensitive location are therefore taken to be:

- Daytime (07:00-23:00): $L_{AF90,5min}$ = 47dB
- Night-time (23:00-07:00): $L_{AF90,5min}$ = 43dB

In the BS4142 method, the L_{Aeq} due to the new noise source(s) is calculated at the position of the nearest or most affected noise sensitive location. If the noise source is considered to be tonal or impulsive in nature then a 5dB penalty is added to the L_{Aeq} level to give a "noise rating" level. Otherwise, the noise rating level is simply taken as the L_{Aeq} value. It is not proposed to apply the 5dB penalty because the plant is expected to have a broad-band noise spectrum without tonal or impulsive characteristics.

The BS4142 method states that if the "noise rating" level (in this case $L_{Aeq,5min}$) is at least 10dB below the "background noise level" (measured by $L_{AF90,5min}$) then this is "a positive indication that complaints are unlikely". In order to achieve this, the proposed target noise levels at the nearest noise sensitive locations resulting from plant operation are therefore:

- Daytime (07:00-23:00): $L_{Aeq,5min}$ = 37dB
- Night-time (23:00-07:00): $L_{Aeq,5min}$ = 33dB

Plant Noise Emission Limits
It is anticipated that the significant items of noise generating plant associated with the development will be as indicated in Table 6.2.

Table 6.2 also summarises the anticipated noise emissions for each item of plant (including proposed noise control measures such as attenuators, barriers, acoustic louvres) in terms of the sound pressure level at a distance of 3m. The list of plant equipment is provisional at this stage and details will be confirmed as the design develops. It is proposed that equipment and noise control measures are selected so as to maintain the noise emission values in Table 6.2.

Table 6.2 shows the distance from each plant item to the nearest noise sensitive location and the noise level that will result at the nearest noise sensitive location.

It can be seen that the combined noise level from all plant operating simultaneously is consistent with the target level described above.

Item	Location	Operation	Proposed Equipment	Noise emissions [at 3m]	Distance to nearest noise sensitive location	Resultant noise level at noise sensitive location
Air-source heatpumps	Mezzanine level plant room over bike store	24-hour	TBC	67dB(A)	30m (no line of sight)	32dB(A)
Air handling unit	Mezzanine level plant room	24-hour	TBC	45dB(A)	25m (partial line of sight)	26dB(A)
Kitchen supply intake louvre	South façade at ground level.	daytime only	TBC	55dB(A)	20m (no line of sight)	30dB(A)
Kitchen extract exhaust cowl	Rooftop	daytime only	TBC	55dB(A)	17m (no line of sight)	33dB(A)
Ventilation exhaust outlets	Rooftop	24-hour	TBC	50dB(A)	20m (no line of sight)	23dB(A)
Miscellaneous Plant	Basement level plant rooms	24-hour	Totally enclosed, no issue with noise break-out			
					TOTAL	**33dB(A) night-time 37dB(A) daytime**

Table 6.2: Summary of proposed, noise generating plant equipment and resultant noise level at nearest noise sensitive location.

Activity Noise
The most significant source of noise is likely to be the Lecture/Performance Hall at ground floor level. The Hall can be fully mechanically ventilated (with silencing provided) at acoustically critical times, and the envelope will give a high sound reduction performance, including high performance glazing and substantial internal lining to prevent noise breakout, as well as internal absorption to reduce reverberation levels. It is therefore not expected that there will be any detrimental impact on surrounding occupiers from activity noise provided that Hall is not used for very noisy events late at night.

6.5 Indoor Ambient Noise Levels

The measured noise levels place the student accommodation into PPG24 Noise Exposure Category B with the following advice:

"*Noise should be taken into account when determining planning applications and where appropriate, conditions imposed to ensure an adequate level of protection against noise*".

BS8233 makes the following recommendations for internal noise levels:

- Bedrooms, "good" standard: $L_{Aeq,8hr}$(11pm-7am)<30dB
- Bedrooms: L_{AFmax} should not normally exceed 45dB during the night-time period.

Table 6.3 shows the anticipated external noise levels at each façade of the building and the level difference to which the façade (including trickle vents) must be designed to achieve.

It is suggested that it is acceptable that the indoor ambient noise levels rise slightly above the BS8233 standard when windows are open to provide purge ventilation.

Façade	LAeq,8hr(11pm-7am) [dB]	LAFmax [dB] (95 percentile during night)	Façade level difference [dB]	Composite façade Rw+Ctr [dB]
East (Walton Street)	56	73	28	28
North (Worcester Place)	51	68	23	23
South and West	51 or less	68 or less	23	23

Table 6.3: External noise levels and façade sound insulation performance.

6.6 Summary

- A noise survey of the site was undertaken between Wednesday 4th and Sunday 8th April 2012.
- The most significant sources of existing noise at the site are road traffic on Walton Street and general activity noise.
- The lowest background noise level was measured to be $L_{AF90,5min}$ = 47dB during the daytime (7am-11pm) and $L_{AF90,5min}$ = 43dB at night (11pm-7am).
- The average noise levels were measured to be $L_{Aeq,16hr(7am-11pm)}$=55dB and $L_{Aeq,8hr(11pm-7am)}$=51dB.
- It is proposed that all plant and associated noise control measures will be designed such that the total $L_{Aeq,5min}$ noise level from plant operation does not exceed the existing $L_{AF90,5min}$ background noise level at any time, when assessed at the nearest noise sensitive locations.
- The nearest noise sensitive locations are taken to be bedroom windows to houses on Worcester Place and Worcester College Student Accommodation.
- Suitable noise emission limits are proposed for each plant item such that the target noise level is achieved at the nearest noise sensitive locations.
- The existing noise environment places the student accommodation into PPG24 Noise Exposure Category B. It should be noted that PPG24 is now defunct but has been used here on account of it being referred to in the Oxford Local Plan.
- Suitable façade sound reduction performances are proposed such that the indoor ambient noise levels in student bedrooms achieve the BS8233 "good" standard.
- The Lecture Hall is being designed to accommodate reasonably noisy activities, with silenced mechanical ventilation and acoustically-insulating building fabric.
- Based on the analysis described, it is not expected that the proposed development will have a detrimental impact on surrounding occupiers in terms of noise.

MAX FORDHAM

7.0 APPENDIX – GLOSSARY OF ACOUSTIC TERMS

SOUND PRESSURE LEVEL (SPL), L (dB)
The sound level measured on a logarithmic scale, with unit decibel dB. This scale is linearly weighted, as opposed to A-weighted (see below). A free-field SPL refers to a level determined far enough from surfaces or facades, apart from the ground, so as not to be influenced by reflections from those surfaces.

A-WEIGHTED SOUND PRESSURE LEVEL (SPL), L_A (dBA)
A-weighted SPL values (or noise levels) are weighted in a way that approximates the frequency response of the human ear and allows sound levels to be expressed as a single figure value.

EQUIVALENT CONTINUOUS A-WEIGHTED SPL, $L_{Aeq,T}$ (dBA)
Energy weighted average of the A-weighted sound pressure level over a time period, T. The level of a notional continuous sound that would deliver the same A-weighted sound energy as the actual fluctuating sound over the course of the defined time period, T.

MAXIMUM A-WEIGHTED SPL, L_{Amax} (dBA)
The maximum A-weighted sound pressure level measured. If not specified, usually assumed to mean L_{AFmax}, i.e. L_{Amax} determined with a 'fast' (F) sound level meter time constant of 125 ms.

BACKGROUND NOISE, $L_{A90,T}$ (dBA)
The value of the A-weighted sound pressure level that is exceeded for 90% of any given time interval, T. This value is generally adopted as representing the background noise level of a given environment. If not specified, usually assumed to mean $L_{AF90,T}$, i.e. $L_{A90,T}$ determined with a 'fast' (F) sound level meter time constant of 125 ms.

ENVIRONMENTAL NOISE SURVEY AND SOUND LEVEL METER DETAILS
The measurements were made with a Norsonic 118 precision sound level analyser (serial number 31419) with a Norsonic 1206 microphone (serial number 30457). This equipment complies with BS EN IEC 61672 class 1. Further details are available on request, including the calibration certificate for the equipment used.

The sound level meter was field-calibrated at the beginning and end of measurements with a Nor 1251 sound calibrator (serial number 30895), complying with BS EN IEC 60942 class 1. No significant calibration deviation occurred. The sound level meter batteries were also checked both before and after the measurements.

SPECTRUM ADAPTATION TERMS, C and Ctr (dB)
These are the values to be added to Dw values to take account of the characteristics of a particular sound spectrum. C corresponds to pink noise spectra and Ctr corresponds to typical urban traffic noise spectra.

PPG24
Planning Policy Guidance Document 24 (2006) "Planning and Noise" (ISBN 9780117529243).

BS 4142
British Standard 4142 (1997): "Method for rating industrial noise affecting mixed residential and industrial areas" (ISBN 0 580 28300 3)

BS 8233
British Standard 8233 (1999): "Sound insulation and noise reduction for buildings – Code of practice" (ISBN 0 580 33009 5)

8.0 APPENDIX – NATURAL RESOURCE IMPACT ANALYSIS (NRIA)

MAX FORDHAM

8.1 Energy Efficiency

How will the design and layout ensure that energy is used efficiently in the scheme?

1 Has an energy strategy been prepared?

Yes. Please refer to the energy strategy section of this report for details.

2 How is the development designed to maximise beneficial solar gain? (through orientation, spatial layout and systems design)

The long axis of the site is approximately east-west, giving possibilities for use of sunshine to the south elevation. The south quad will be warmed by the sun in summer, but shaded by trees. Summer solar gains to the south bedrooms are naturally controlled through the presence of semi-deciduous trees in Worcester College opposite – these trees allow some limited solar gain through in winter to benefit the bedrooms.

Solar thermal panels will be provided to heat the domestic hot water, providing around 50% of the annual hot water demand.

3 How will the design of the building make efficient use of energy? (linked buildings, buffer zones, thermal mass etc.)

Our approach to the design of the building has been to reduce energy demands through control of the building form and fabric, then avoidance of energy wastage e.g. with heat recovery, before adding renewable energy generation technologies.

The semi-external cloisters are heated only by fortuitous solar gains and conduction from adjacent heated spaces, and are effectively draught lobbies for the main ground floor spaces.

Exposed concrete soffits are provided throughout much of the building, which will be used in conjunction with a night purge ventilation strategy during quiet periods on summer nights to reduce cooling requirements for the following day.

The main ventilation load, the Kitchen, is provided with heat recovery.

How will the construction of the buildings ensure efficient use of energy and reduce overall energy use?

4 What insulation standard will the development be built to?

The building will be built to an insulation standard equivalent to a 40% improvement on the Part L 2010 requirements.

Building Thermal Performance		
Glass Façade U-value:	1.4 W/m^2K	40% improvement on Part L 2010.
Solid Façade U-value:	0.25 W/m^2K	
Roof U-value:	0.15 W/m^2K	
Floor U-Value	0.15 W/m^2K	

5 How is the development designed to minimise unwanted air infiltration?

The building will be built to an air tightness level that is 50% better than that required by Part L 2010 through the use of airtight construction details.

The construction will aim to achieve $5m^3/hr/m^2$ @50 Pa

6 What glazing standard will the development be built to?

The glazing will be specified to a performance of 1.4 W/m2K U-value (for the full assembly including framing), and 0.3-0.5 g-value depending on the orientation.

How will the mechanical and electrical systems of the buildings ensure efficient use of energy and reduce overall energy use?

7 What efficiency standard will boilers be specified to?

There are no currently no boilers within the scheme. If boilers were to be added to the scheme for back-up purposes these would be high efficiency condensing gas boilers and as such would have a typical efficiency of above 95%.

8 Will the development be linked to a combined heat and power plant or to a district heating system? (please provide details)

No because there are no local district heating schemes (CHP or otherwise) of appropriate scale on offer within a reasonable distance for connection. Micro/Mini gas CHP has been considered and - although the demand profile is a reasonable fit due to the relatively high hot water demand – solar thermal panels offer better and more renewable hot water provision and are being provided (see other sections).

9 How has the development been designed to maximise controlled natural ventilation?

The design of the internal spaces and opening windows within the façade has been optimised to maximise the usage of natural ventilation within the space. Where practical, all spaces are to be naturally ventilated with the exception of the following:

Student bathrooms – mechanical extract is required (although make-up air is provided via trickle-vents).

Office / Teaching spaces – the internal gains for these spaces are high so a mixed-mode system will be used.

Kitchen – a very high rate of ventilation is required for the kitchen so it is not practical to naturally ventilate this space.

Paper Archive – tight control of environmental conditions is required here and natural ventilation is not appropriate.

See the ventilation section of this report for further details.

10 Will any mechanical ventilation to be incorporated be of high efficiency?

Where practical, spaces are to be naturally ventilated. In areas where mechanical ventilation is used, fans will be selected on the basis of excellent efficiency, and the ductwork sized to give low pressure drops, limiting the frictional loss and improving the efficiency of the system.

Heat recovery will be included on the Kitchen and Office/Teaching systems. The cost-benefit of heat recovery to the student bedrooms was judged to be marginal due to the similar operational cost and higher estimated capital cost for these spaces.

See the ventilation section of this report for further details.

11 How has the development been designed to maximise natural daylight?

Large windows and rooflights are provided where appropriate to maximise natural daylighting. Within the student bedrooms, a large window is provided to give good overall daylight through the room and a smaller additional window is provided by the desk to provide additional daylight onto the task area.

Daylight dimming will be incorporated in spaces with high glazing areas to make the best use of the natural light available.

Dormers and end windows are provided to corridors to afford some natural light to these spaces.

Rooflights and large glazed doors are provided to the Hall, and rooflights allow light down to some of the lower ground floor spaces.

See the daylighting and artificial lighting section of this report for further details.

12 How will the development incorporate high-efficiency lighting?

High efficiency LED fittings will be used wherever appropriate within the building. These have high efficiencies and long life spans, so their whole life energy use is good. Generally lighting will be specified to achieve at least 55 lamp-lm/circuit-W efficacy, including display lighting. Lighting will be provided with automatic daylight and/or occupancy based controls to avoid lighting spaces unnecessarily.

See the daylighting and artificial lighting section of this report for further details.

13 how will the development incorporate high-efficiency appliances (where installed)?

Any built-in domestic appliances will be A+ rated.

14 How will the heating, lighting and ventilation systems be controlled?

Generally the control systems introduced will be designed to minimise the energy use through a combination of carefully designed aspects of user-control, balanced with non-intrusive automatic controls.

Heating:

The heating system will be zoned to reflect the uses of the building and will generally be controlled using proprietary local controls with centrally imposed limits / set points and local user adjustment.

Conservation heating will be provided to the archive, which will be automatically controlled via space temperature and humidity sensors.

Lighting:

The lighting system will incorporate central switching with daylight dimming for circulation areas; PIR control for bathrooms; and local user controls with dimmable fittings for other spaces (except bedrooms, where the fittings are not dimmable).

Ventilation:

Student rooms:

Natural ventilation to student rooms is provided via manually opening windows. For the bathroom extract, the extract fan and make-up air trickle-vents will be automatically controlled via a central time-clock speed control.

Circulation and congregation areas are to be naturally ventilated with motorised automatic windows/rooflights. These are to be controlled on CO_2, followed by external vs. internal temperature, with manual override. The controls will be programmed to optimise the frequency of opening.

8.2 Renewable Energy

How will the design incorporate the use of energy from renewable sources on-site?

15 Will the development incorporate the use of biomass as a fuel? (please provide details)

No, it has not been judged to be practical due to the space constraints of the site and the city-centre location.

16 Will the development incorporate the use of heat pumps? (please provide details)

Yes. Air source heat pumps will be incorporated to provide space heating and some cooling.

Please see the energy strategy section of this report for further details.

17 Will the development incorporate active solar water-heating systems? (please provide details)

Yes. Solar thermal water heating systems will be incorporated to provide heating for the domestic hot water systems.

Please see the energy strategy section of this report for further details.

18 Will the development incorporate solar electricity generation? (please provide details)

No. Appropriate areas of roof have been given to hot-water generating solar thermal cells in preference.

19 Will the development incorporate a micro-hydro scheme? (please provide details)

No. No appropriate watercourse is available on the site.

20 Will the development incorporate wind-energy electricity generation? (please provide details)

No. The city centre conservation area location makes wind generation potentially less attractive.

8.3 Choice of Materials and Embodied Energy

How will the materials specified minimise embodied energy, energy in use and environmental impact?

21 How will the materials be specified to ensure a low level of embodied energy?

The design incorporates limited amounts of timber (e.g. glazing framing, furniture) but is in general based around concrete and steel, with stone and stainless steel cladding. Timber was considered as the primary structure but was discounted on the basis of longevity and robustness, in the context of the project.

The concrete will be specified with a high percentage of recycled aggregates and cement replacement, provided that it is possible to procure it from close enough to the site that its transportation energy does not exceed the production energy of alterative products.

Stone will be sourced locally to reduce transportation carbon.

Thermal insulation will be glass fibre with a high recycled content, reducing its embodied energy.

22 How will the materials be specified to prioritise those with minimal environmental impact?

As stated in Q21, concrete will be specified with high recycled content.

Timber used in the construction will be specified from FSC sources.

Thermal insulation will be specified with a low global warming potential (GWP normally <5).

Deleterious materials will not be permitted and PVC will be avoided where possible.

23 Will the materials be sourced locally?

As in Q21, the stone cladding and concrete constituents will be sourced locally. The stainless steel cladding is sourced from north London.

24 How will the materials and systems be specified to ensure a good quality internal environment?

In parallel with our consideration of the impact of construction materials on the wider environment, we are also bearing in mind the possible effects of materials on the indoor environment. Materials with high VOC content or liable to produce significant off-gassing will be avoided in sleeping accommodation and in the paper Archive. These will be controlled using specification documents to be produced later in the design process.

Building services systems are being designed with noise targets in mind, particularly in sleeping accommodation (<NR25). Air pollution to the internal environment is reduced by excellent levels of natural ventilation and appropriate kitchen and WC ventilation.

Lighting systems will be specified to avoid glare, especially in study areas.

Generally the architectural scheme is intended to produce a good quality internal environment through good design and attention to detail.

25 How will the timber be specified to ensure it is from the most sustainable sources?

Only FSC timber will be specified and the contractor will be required to demonstrate this.

26 Will contractors and suppliers be chosen with regard to their environmental management record? (please provide details)

Maxfordham, the environmental engineers, will be part of the team assessing the tenders, and have ISO14001 environmental stewardship accreditation

There will be a contractor pre-qualification process which will include as part of the assessment a requirement to demonstrate environmental accreditations.

Recycled Materials:

How will the buildings be re-used and/or demolition waste be responsibly dealt with?

27 How will the development make efficient use of all material resources on site (for example existing buildings, services, infrastructure and topsoil?

A significant amount of existing material in the retained façade is being re-used.

The existing topsoil is being used to establish the temporary piling mat for the new foundations.

The existing utility connections are being retained and re-used.

28 Has a strategy for the minimisation and handling of waste be prepared? (please provide details)

A site waste management plan has been drafted and will be implemented and maintained throughout the project. Please refer to the attached Site Waste Management Plan.

The contractor will be required in the contract preliminaries specification to deal with construction waste responsibly.

How will waste be minimised and the materials and construction methods used in the development make best use of recycling?

29 How will the development make maximum use of recycled materials?

As stated in Q21 and Q22, concrete and thermal insulation with high recycled content will be used. Availability of recycled versions of other products will be considered on their individual merits in the detailed design, accounting for local availability.

30 How will the development make maximum use of construction and demolition waste arisings?

As stated in Q27 above, the excavation spoils will be re-used on site for the temporary piling mat before being eventually transported away to make way for the required new basement. Crushing of aggregate on site is unlikely to be cost-effective, due to the space constraints of the site for storage, and the certification of readimix. However this will be considered in discussions with the demolitions contractor.

The demolition contractor will be required to make a statement demonstrating how they will re-use or sell the demolished parts of the existing buildings where possible.

31 How is the development designed to incorporate materials/elements that will be simple to re-use/recycle at the end of the buildings life?

The building's intended operational life is well over a century, so although it is important to be able to recycle construction products, the energy and materials used in operation and maintenance should outweigh those used in initial construction. Also it is not clear what types of materials will be most easily recyclable at the end of the building's life. Generally it is easier to recycle pure rather than composite materials, and this is borne in mind in the design.

We expect the concrete frame to be crushable at the end of the building's life, subject to the same issues of site constraint and quality certification described in Q30 above.

The stainless steel cladding should be relatively easily recyclable, as should the steel frame.

How will domestic/commercial waste generated in the development be dealt with?

32 How will provision be made for the storage/collection of waste generated in the development?

There are two groups of bins indicated on the Architect's ground floor plan, number 0502-A-X-00-01 0, one for domestic waste and one for commercial waste. For domestic waste there are 8 bins shown, more than has been requested by the council refuse department. Of these bins it is intended that paper, cardboard, glass and plastic will all be separated. The additional four bins allow for residual waste and any extra requirements that may arise. For trade waste there is space allocated for four eurobins and, if necessary, a compactor. The two groups of bins are within the distance required by BS 5906 to be wheeled to the roadway for collection by the refuse collectors, and the ramp also meets the requirements of that BS. It is anticipated that collections of domestic waste will be daily, while those for trade waste will be once or twice per week.

Waste is removed daily by domestic staff from all student rooms and the student kitchens. The catering staff will remove waste from the café and kitchen on a similar basis.

33 How will the development provide opportunities and facilities for home/community composting?

This is not specifically considered in the design at this stage. It will be up to the users of the building to make appropriate provisions for composting if this is judged by them to be appropriate in the future.

The College generally deals with composting at its main Turl St site.

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8.4 Water Resources

How will water resources be conserved and recycled?

34 How will the development incorporate the use of water-saving devices?

The Sanitaryware will be specified by the Architects to minimise water use whilst maintaining comfort: low flush WCs, spray taps on wash hand basins, and low volume showers will be specified for the student and guest facilities.

The kitchen appliances will be specified with efficiency of water use in mind.

35 How will the landscaping be designed to minimise water consumption?

The landscaping strategy is made up of discrete areas of planting with carefully selected plants appropriate to the local environment or drought resistant (e.g. Rhus Typhina). There are no lawns or large areas of high-maintenance planting. The south boundary is dominated by the adjacent college's Holm Oaks and minimal additional borders are proposed.

Rainwater-harvesting is proposed. Rain water will be collected from the roof areas and stored in large underground tanks at either end of the site. From there it will be delivered to a day tank in the basement plantroom for re-use in WCs around the site.

36 How will the development incorporate the harvesting and re-use of rainwater?

Rainwater will be harvested from the roofs and stored in tanks on site for use for WC flushing. The system will likely comprise of a day tank of around 1000l and two large basement bulk water tanks of around 100,000l total, providing for 1 month storage for exceptionally dry periods.

37 How will the development incorporate the collection, treatment and recycling of grey water?

The development does not incorporate the collection, treatment and recycling of grey water.

8.5 NRIA Checklist

All NRIAs must be submitted with a completed checklist, whether the NRIA template has been used or not. This information will be used to supplement the details submitted in the earlier sections of the NRIA. Tables 1–3 should be used to calculate the value for questions C1, C3 and C4 and must be submitted as part of the NRIA.

Rarely is the City Council likely to approve a development where a score of six is not achieved including at least the minimum standard in each section.

			Minimum standard		Preferred standard		Target standard		Score achieved
Energy efficiency	C1	**Residential uses:** What is the SAP rating? (See table 1)	SAP "good" (GS1)	1 pt	SAP "best" (BS1)	2 pts	SAP "advanced" (AS1)	3 pts	**3**
		Non-residential uses: Under criterion 1 of SBEM: what is the relationship of the Building Emissions Rating (BER) to the Target Emissions Rating (TER)?	BER = TER	1 pt	BER is 2% better than TER	2 pts	BER is 5% better than TER	3 pts	
Renewable energy	C2	What percentage of energy requirements will be produced by on-site renewables?	20%	1 pt	30%	2 pts	40%	3 pts	**2**
Materials	C3	What score is achieved in table 2?	4	1 pt	5-7	2 pts	8-11	3 pts	**2**
Water resources	C4	What score is achieved in table 3?	1	1 pt	2	2 pts			**1**
								Total checklist score:	**8/11**

Dwelling Type	**"Good" (GS1)**			**"Best" (BS1)**			**"Advanced" (AS1)**		
	Cost Saving (£/yr)	CO2 Saving (kg CO2/yr)	SAP	Cost Saving (£/yr)	CO2 Saving (kg CO2/yr)	SAP	Cost Saving (£/yr)	CO2 Saving (kg CO2/yr)	SAP
Flat	19	94	102	42	375	108	>58	>569	128
Detached Bungalow	36	331	100	55	554	106	>73	>782	124
Semi-detached Bungalow	34	300	100	50	487	106	>67	>700	124
Mid-terraced	28	161	102	56	502	108	>78	>769	128
End-Terraced	35	261	100	61	570	107	>84	>851	127
Semi-detached	41	331	100	66	614	107	>90	>910	126
Detached	55	513	101	83	823	107	>108	>1137	125

Table 1 – SAP ratings

	Minimum standard	Score	Preferred standard	Score	Target standard	Score	Score achieved
Aggregates use	Some recycled aggregate used on site.	1	Recycled aggregate from off – site sources used for >60% of all aggregate consumed on site	2	Recycled aggregate from on-site demolition used for >60% of all aggregate consumed on site	3	**1**
Timber use	Softwoods from temperate managed forests used. No tropical hardwood from non certified sustainable sources	1	FSC or equivalent certified timber, and / or recycled or reclaimed timber used in <90% of the timber uses on site (by volume). Rest of timber from temperate managed forests	2	FSC certified timber (or equivalent) and/or reclaimed timber used in 90% of timber uses (by volume)	3	**3**
Insulation materials	From fossil fuel sources, with no ozone depleting blowing agents	1	From recycled materials	2	From naturally occurring sources	3	**2**
Sourcing strategy			Average distance travelled by materials (by weight) to be <100 miles (Industry average)	1	>50% of materials (by weight) to be sourced from within 35 miles (achieved by BedZed)	2	**1**
							6/11

Table 2 - Choice of materials

	Minimum standard	Score	Preferred standard	Score	Score achieved
Residential	54m³/bedspace/year	1	37.5m³/bedspace/year	2	**1**
Offices	9.3m³/person/year	1	6.4m³/person/year	2	
Schools	3.9m³/pupil/year	1	2.7m³/pupil/year	2	
Hospitals	1.66m³/m²floorspace/year	1	1.38m³/m²floorspace/year	2	
Further & Higher Education	0.62m³/m²floorspace/year	1	0.4m³/m²floorspace/year	2	
					1/2

Table 3 - Water Resources