THE MANCHESTER COLLEGE

NICHOLLS CAMPUS
EXTENSION

ENERGY AND SUSTAINABILITY REPORT

TO ACCOMPANY PLANNING APPLICATION

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Project No:	EJ328
Date:	August 2012
Rev:	Rev A

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1.0 EXECUTIVE SUMMARY

This report has been developed to help identify the likely energy strategy and impact for the proposed development at The Manchester College Nicholls Campus.

The proposed development includes for the demolition of an existing single storey accommodation block and the new build of a single storey refectory, reception area and staff facilities in its place. It also includes the conversion of the existing refectory into teaching spaces.

The need to supply sustainable design techniques within the building services systems is recognised and consideration will be given to this need throughout the whole design process and through construction and commissioning of the building.

The design and specification of building services has a key influence on the performance of the buildings. They determine the operating cost of the building and they influence the building's impact on the environment and the influence of comfort and well being of the building occupants.

A range of renewable technologies are considered within this report, together with a review of available low cost techniques to manage energy consumption through the life of the building.

The development will comply with the Building Regulations, Part L, 2010. These regulations place a much greater emphasis on buildings energy performance and carbon emissions. The targets set by the building regulations will require a greater level of thermal performance from the building design, both in terms of U values and air permeability.

The design is still at an early stage and there is extensive modelling and calculation to take place to determine the details of the energy consumptions, carbon emissions and the savings that would be made through the design and use of low zero carbon technologies. However, the recommendations are that the building is designed with low energy use as a key aspect. This will cross the fabric selection, air permeability selection and building services system design. This will allow an efficient use of renewable energy sources to gain maximum benefit from their use and obtain a building which complies with the regulations. This design will align with the project requirements for achieving an excellent BREEAM rating.

Final selection of renewable technology is dealt with in this report and the detail will be developed during the next stages of design.

2.0 INTRODUCTION

The purpose of this report is to consider the effective use of energy resources for the development and to identify how the reduction in CO_2 emissions from the proposed development and the reduction of the use of finite, non-renewable resources (fossil fuels) and the reduction of other emissions related to building energy use (e.g. NOx) will be achieved.

The options considered address the following issues in order to realise design intent and achieve the desired performance from the building:

(i) Reduce energy loads wherever possible.
(ii) Provide energy input as efficiently as possible.
(iii) Minimise plant operation times - default to 'off' or 'standby'.
(iv) Use the simplest solutions that will satisfy the Client's requirements and be manageable by the end users.
(v) Incorporate sustainable technology where possible.
(vi) Enable energy management.

There have been no targets set for "carbon neutral" or "net zero carbon" for this development as this will likely be unachievable.

This report will demonstrate that the project design team has given thorough consideration to all zero and low CO_2 technologies that could be employed to meet a proportion of the buildings energy demand.

This report will demonstrate the building energy demand and show the energy related CO_2 savings that can be made through energy efficiency measures, efficient supply of energy and incorporation of a variety of renewable energy sources.

3.0 GENERAL DESCRIPTION OF EXISTING SITE

The proposed development includes a single storey, new build facility providing refectory and reception facilities. The development will be located close to existing buildings on the same site and will provide a link between two existing buildings on site.

The site is located slightly outside of the Manchester City Centre ring road, within Ardwick.

4.0 ESTIMATED ENERGY CONSUMPTION

The energy consumed at the completed site will include both electricity and fossil fuels. Estimations of energy use will be determined from incremental levels of calculation. Early estimates contained in this report are based on preliminary thermal modelling work completed to assist planning application.

Further, more detailed calculations and modelling will need to refine these figures to demonstrate Regulations compliance and inform the final decisions on energy use, on site generation possibilities and systems design.

5.0 DESIGN PROPOSALS

Whilst the building proposed is relatively small in size, there are a number of different areas of accommodation to be provided. Each of these will need consideration of the servicing and environmental control techniques necessary to make the building use at its optimum. It is currently anticipated that the building will have an airtightness and 'U' values beyond the requirements of Building Regulations Part L. These are scheduled within Appendix A of this report within the Model Data Section of the Thermal Modeling Assessment.

Once the thermal and infiltration properties of the building have been established, the services elements can be considered in more detail. Generally, the lighting power densities for all the areas have been set at tight targets in the order of 2.4 - 2.8W/m^2/100 lux. These will be difficult to achieve but necessary as the overall contribution to the energy load, from lighting, is high in proportion to the rest of the systems.

LED lighting shall be provided wherever possible and automatic control including daylight control should be provided to help minimise the energy consumption of the lighting.

Natural ventilation will mostly be used throughout. Mechanical ventilation will be provided to WC's and to the existing refectory area that is to be converted into classrooms. Natural ventilation through windows and roof vents will help to maintain summer temperatures and with occupant control give background and rapid vent.

Domestic hot water will be generated via point of use heaters.

The above outlines the principal servicing strategy for the building for those elements that affect the energy calculations. These are reflected within Appendix A of this report where the scenarios have been inputted into a thermal model which has been produced for the purpose of this Planning Application supporting document.

The results of this report and the thermal model indicate that, with the brief for BREEAM excellent, we will have a building that outperforms Part L by at least 25%. The use of specific renewables has been left undecided. However, it is likely that any renewables will be solar PV and the extent of these are described elsewhere in this report and within Appendix A.

6.0 ENERGY AND SUSTAINABLE DESIGN OPTIONS CONSIDERED

The following section details the elements of design that should be considered in terms of energy and sustainability for the majority of developments to determine which elements are most suitable for that particular development.

6.1 Fabric and Structural Design

6.1.1 Thermal Buffering

Unheated spaces such as draught lobbies and conservatories are valuable as thermal buffers to reduce the temperature drop/rise across the wall bounding the heated or cooled property.

In order to maximise the potential of this methodology entrances to the property should be equipped with buffer areas and should be located where heat losses/gains are at their highest. It is therefore recommended that buffer zones are introduced to the main entrances to the buildings.

6.1.2 Thermal Mass and Admittance

By manipulating the building design and incorporating high admittance materials into the structure, peak internal temperatures can be minimised resulting in the reduction or elimination of cooling plant. When considering thermal mass storage careful consideration has to be afforded to the extent and location of any material used and as to the location of the accompanying services. Addressing a single item in isolation of any other controlling factor is a recipe for disaster. However when successfully incorporated, the benefits of reduced or eliminated cooling costs can be high.

Heat which is stored in the building structure during the daytime must be removed at night to avoid the building temperature rising steadily during the week. This is often overlooked or not adequately accounted for by designers and occupants, either because of poor ventilation design or lack occupant or management education.

High ceilings can also increase the admittance of the respective room and can therefore help reduce peak summer temperatures. An increase of ceiling height from 2.5 m to 3.5 m in a typical office can reduce peak temperatures by approximately 1.5^{o}C. However other significant effects of high ceilings are to increase the required heating load during winter months and a balance must be made which does not dramatically impede on either cooling or heating costs.

The final selection of materials for the buildings within the scheme have yet to be determined. Discussions amongst the Design Team and with the Architect and Client have indicated that the building structures will be of generally traditional materials, well insulated with the use of masonry which creates greater admittance values and thermal buffering. It is anticipated that this will be further detailed at the next stage of development to allow the results of the thermal modelling options to influence the final material selection.

6.2 Passive Solar Design, Daylighting, Minimising the Need for Servicing and Natural Ventilation

In order to achieve the objectives listed in Section 2, a design that pursues passive control of the environment is the preferred option. The application of passive solar features to reduce a buildings susceptibility to solar gain and the need for mechanical ventilation or indeed air conditioning is a worthwhile consideration. Any solar shading design should prevent solar gains from entering the building and is therefore best suited to external application. In addition to this, natural daylight should also be permitted to enter the building during winter months when the associated solar

gains cab be utilised to offset the heating requirement. The opportunity to include these options will be considered in conjunction with the Architect as the design develops.

Fig 1.2 Solar Shading Installation



6.3 Water Conservation

In the UK as a whole, water consumption has risen by 70% over the last thirty years. In order to meet increasing demand, new sources of water supply have to be created but this is costly and potentially damaging to the environment. An alternative and preferred approach is to reduce the demand for water.

It has been estimated that water savings in excess of 70% can be achieved using water efficient appliances and sanitary ware. The main installations to target are the WC, urinals and hand washing facilities. The water used for these purposes accounts for 90% of the water consumed in a typical building.

All wash hand basins should be equipped with low flow aerating taps along with a means of control by ether PIR or push top. Careful consideration will have to be given to the selection of push taps if these are to utilised, as difficulty in activation may be experienced by specific building users.

Due to the nature of the site and the new build proposed sustainable drainage systems have not currently been reviewed.

6.4 Plant Sizing

The correct sizing of boiler plant is essential to maximise the overall efficiency of the system. Boiler plant is generally sized for times of greatest demand, e.g. mid winter requirements and therefore has considerable surplus capacity for the test of the year. The over sizing of any type of boiler generally results in a reduction of seasonal efficiencies and an increase in capital expenditure on plant.

Over sizing of plant occurs mainly due to the propensity for design safety margins. While over sizing of plant does not generally lead to remedial measures, under sizing of plant can constitute a significant design flaw with resulting financial penalties which tends to encourage the practice of adding additional capacity.

General guidance on avoiding over sizing is given in BSRIA's guidance note 12/97 which identifies trigger levels over which heating plant capacities are likely to be oversized.

Table 1.5 - Trigger Levels for likely Heating Plant oversizing (BSRIA 1997)

Building	Boiler Plant (Heating load W/m^2)
Retail, healthcare and educational establishments	110

It must be noted that individual projects will require specific attention and these rules of thumb do not replace a full calculation of plant capacity. The figures should be used as a check on whether over sizing may have occurred.

In recent years major improvements have taken place to the Building Regulations Part L which deals with thermal efficiency of buildings. These improvements have included substantial changes to acceptable levels of carbon emission from buildings and have concentrated on improving new values as well as plant efficiencies. Whilst the figures quoted above can be used as a check on whether over-sizing may have occurred, it is more likely that overall heating plant sizing would be now expected substantially less than this figure and more likely to be in the order of 50-60W/m^2. The final details of the plant sizing will be determined following full thermal modelling analysis of the scheme.

6.5 Boiler Emissions

NO_x is a collective term for the gases nitrogen oxide (NO), nitrogen dioxide (NO_2), and Nitrous Oxide (N_2O). NO_x is produced by biological and atmospheric reaction, it is also released during the combustion of fossil fuels such as coal, oil, and natural gas in boilers. Excess atmospheric concentrations, caused by anthropogenic (human-derived) emissions, can cause pollution both in air and water.

Reducing the levels of NO_x in the atmosphere will reduce the incidence of acid rain, which damages ecosystems and buildings. It will also reduce the incidences of poor air quality at ground level, which is harmful to people, agricultural crops, and other plants. The effects of poor air quality are usually particularly severe close to the source of emissions, and high levels of NO_x have been measured in offices where air intakes are situated too close to boiler flues.

Boilers in space heating systems always emit NO_x, but the quantity is significantly reduced in some models. NO_x emissions can be reduced by:

- The specification of high efficiency boilers, which reduce both NO_x and CO_2 emissions.
- Minimising excess oxygen to reduce the amount of nitrogen produced.

- Lowering flame temperatures to minimise production of thermal NO_x

The following chart shows the NO_x class ratings against which all new manufactured boilers are rated. All measurements are at 0% excess air and at full load.

Table 1.7 – Class Rating for NO_x Emissions from Boilers

Class Rating	NO_x Emissions	
	mg/kWh	Approximate ppm
Class 1	260	150
Class 2	200	115
Class 3	150	87
Class 4	100	57
Class 5	70	40

It is therefore recommended that the boiler selected for the project , if required as gas fired, should meet at least Class 4 rating (i.e. with NO_x emissions not exceeding 100mg/kWh).

6.6 Lighting

The effectiveness of a lighting installation in meeting the required illuminance level for the minimum power consumption is dependent upon:

- The efficiency of the lamps selected (normally measure in lumens /watt).
- The efficiency of the luminaire in delivering light on the working plane which can be measure in terms of its Light Output Ratio (LOR).
- The efficiency of the control gear (which can be improved with the use of low loss or high frequency ballasts).
- The arrangement of the luminaires.

6.6.1 Efficiency Targets for Lighting

One measure of the effectiveness of a lighting installation is the installed power density to deliver a maintained illuminance. This is usually measured in Watts/m^2/100lux. For general open plan office areas Energy Consumption Guide 19 recommends a Good Practice bench mark of 3W/m^2 per 100 lux.

This building will target a level of 2W/m^2/100 lux.

Under the existing Part L of the Building Regulations there is a requirement to achieve a minimum efficiency for non domestic lighting. At present this is met either by using high efficiency lamps from Table 9 of the regulations or by ensuring that the average initial (100 hour) efficacy across the whole installation is greater than 50 lumens per watt. Under the current proposals for changes to the building regulations it is proposed to introduce a measure which takes account of the Light Output Ratio of the luminaire and the circuit losses as well as the efficiency of the lamp. For general lighting efficacy in office, industrial and storage buildings it is proposed that installations should have 'an initial efficacy averaged over the whole building of not less than 40 luminaire-lumens/circuit-watt'.

This requirement would be met by ensuring that all luminaries have a Light Output Ratio of at least 0.6 and ensuring that only lamp types from Table J1 of the proposed regulations are used. It is therefore recommended that this level of efficiency is adopted and the following standards should be achieved where possible:

- All luminaires should have an LOR of at least 0.6 or greater.
- High frequency ballasts should be fitted to all discharge lamps.
- Only high efficiency lamps as set out in Table J1 in the Building Regulations should be used.

6.7 Lighting Controls

Lighting control, or more specifically the effective utilisation of daylight, is a critical factor in any energy efficient strategy related to buildings. Additionally, lighting controls can have an important role to play in turning the lighting off when the space is unoccupied. The desired result is to reduce lighting energy consumption and the associated heat gains. Results from various field trails have shown that daylight can be poorly utilised even where a building is designed for day lighting. Lighting controls can sometimes be disabled and installations run with lighting on 100% of the time. Increasingly, with the wider use of visual display terminals glare can become a problem and occupants will resort to 'blinds down – lights on' operation to overcome this. The correct design of a control system which allowed sufficient flexibility, coupled with user education, would help over come some of these problems.

Any design must therefore tackle the problem of the provision of an acceptable level of day lighting within the constraint of minimal total energy consumption, considering heating, cooling and lighting energy use. It must provide a control system which is effective in utilising daylight without robbing the occupant of personnel control. Visual comfort must also be considered in this strategy, particularly in the case of disabling glare and its effects on visual display terminals.

Internal décor has a dramatic effect on the need to alter lighting levels and this interaction should not be ignored. This interaction may be either useful in a sensitive integrated scheme or counterproductive if the designer and lighting engineer work in ignorance of each others activities.
As a result of the need to maximise the use of natural day lighting the installed lighting system should be adaptive so as to maximise any potential savings. Fittings should include daylight-following, presence sensing, dimmable, high frequency fluorescent lighting, in accordance with CIBSE Lighting Guide LG3 to provide flicker free, comfortable lighting.

Occupancy controls should be installed which would take the general lighting level down to a predetermined 'security' level after 10 minutes of failing to detect presence. Sensors should be arranged sufficiently closely together to enable any occupant to move slightly to reactivate their zone. Consideration should also be given to prevent 'hunting' or frequent switching when using automatic controls. The run up and re-strike characteristics of the lamps should be taken into consideration when using controls of this type.

Any external security lighting should be time and daylight controlled.

6.8 Services Control

Control of heating and lighting systems within buildings is a critical aspect in achieving a low energy building but careful consideration has to be afforded to both the complexity/usability and the maintenance requirements of such plant. Building management systems available today offer great flexibility but become increasingly difficult to maintain and operate and a decision on the selection of such equipment will be dependant upon the required level of control. Measures such as zone control, optimisation and weather compensation should be considered as standard due to the potential savings in energy that can be achieved.

In order to satisfy these requirements it is proposed that the heating and ventilation systems should be zoned to accommodate the predicted partial occupancies and have the ability to enable 'day time set back' for areas, which are used periodically throughout the day. To achieve these facilities along with the provision of optimised time control and weather compensation the selected control device would have to involve the use of a building management controller. To remove these control options in favour of a simple control facility would dispose of the opportunity to reduce gas and electricity consumption by as much as 40%.

Lighting and ventilation to toilet areas should be controlled by the use of PIR occupancy detectors so as to minimise running times.

Thermostatic radiator valves provide effective local control of individual heat emitters and are very useful where there are significant incidental heat gains and local control is required. They should however only be relied upon for localised temperature control, varied timed occupation should be provided by localised zone valves.

6.8.1 Location of Temperature Sensors

It is essential that internal and external temperature sensors are installed correctly to achieve efficient and effective system operation. Incorrect siting of such devices can result in thermal comfort conditions being exceeded and unnecessary energy consumption.

Consideration should therefore be given to ensuring the following guidance is included in any specification and design:

Internal room temperature sensors should be located:

- Away from sources of draughts.
- Not in partitioned offices which may have different conditions than general space.
- Away from sources of heat (including heat produced from emitter).
- Out of reach of direct sunlight.
- Not on an external wall.
- Approximately 1500mm from the floor.
- In a position which is unlikely to be covered.

External sensors should be located:

- Out of reach of direct sunlight (north facing wall or shaded).
- Away from any heat sources, exhausts, open windows.
- In a safe / tamperproof location.

6.9 Solar - Photovoltaic (PV)

PV systems are normally installed to reduce the need to consume electricity from the grid and in some cases it becomes viable to export and sell surplus electricity back to the grid. The decision to undertake such an arrangement will be dependant upon a number of factors:

- Need for LZC technology to be able to achieve a compliant, Building Regulations Part L, 2010, scheme design
- Size of installed PV system.
- Require load to property and time of peak electrical consumption.

Recent improvements have been made to encourage small scale PV installations. In particular the tightening of regulations on allowable carbon emissions for new buildings, and the introduction of Feed In Tariff incentives from the Government.

On average the installed cost for small to medium PV systems is in the region of £6-8,000 per kWp generating capacity, which can be considered to be extremely expensive.

However, the benefits which are globally recognised from solar technology are listed below:

- Solar power doesn't generate pollution, noise or waste, hence causes no harm to the environment.
- Solar power has low maintenance requirements.
- Solar power requires no fuel - the sun's energy is free and infinite.
- Solar power has no moving parts and is highly reliable.

- Solar panels have warranties of 20+ years and expected lifetimes of 40-50 years.
- Solar power is the only renewable energy technology that is deployable on a mass scale in urban environments.
- Solar power use actually helps reduce CO_2 emissions; each 1,000kWh of PV generated electricity saves approximately 0.7 tonnes of CO_2 emissions.
- Solar products can replace traditional building materials hence combining functionality, architectural feature and power supply.
- Planning issues are generally less complicated than other renewable technologies.

An environmental aspect which must be considered when selecting this type of renewable energy is the embodied energy costs of the material. PV systems require a great amount of energy in the manufacturing process and dependant upon the type of PV installed, a payback in energy needed to manufacture them will only be achieved after 10 to 15 years. However, with a life expectancy of 40+ years, this should not result in an obstacle for installation.

With the services strategy that is developing for the project, the highest energy load will relate to consumption of electricity.

With this in mind, consideration has been given to the use of PV.

The initial thermal modelling works have identified that the inclusion of 55m^2 of solar PV will allow the scheme to achieve a compliant 2010 Building Regulations, Part L submission and also reduce the on site grid electricity consumption.

6.9.1 Feed In Tariffs (FIT's) (Became available in Great Britain 1 April 2010)

Under this scheme Energy Suppliers make regular payments to communities who generate their own electricity from renewable or low carbon sources such as solar electricity (PV panels or wind turbines). The scheme guarantees a minimum payment for all electricity generated by the scheme system, as well as separate payments for the electricity exported to grid. These payments are in addition to the bill savings made by the electricity generated on site.

6.10 Hot Water Generation

The scheme under consideration requires no new Hot Water Generation. The existing plant and system design will be altered by the proposed changes to boiler plant.

6.11 Wind Energy

Wind energy is probably the most promising of all the renewable energy technologies suitable for use in the UK and with the development of the market, costs have become increasing more competitive and the range of turbine sizes is more acceptable. To date most installations are commercial wind power stations consisting of groups of turbines each rated at about 400kW or above. The technology in developing these systems has produced a reliable and cost effective method of electrical generation.

Small scale wind turbines are still however considered to be relatively expensive compared with medium scale wind turbines (on a kilowatt by kilowatt basis) and to some extend still under development, so it tends to be an expensive option to install a small wind turbine. Whilst potential still exists for such a scheme the following considerations will have to be satisfied:

- Visual Impact / Planning requirements
- Concerns about noise from turbine blades
- Dynamic Forces and Vibration if turbines are to be attached to buildings
- Maintenance and repair
- Safety in the event of extreme failure

- Disruption of wind flows reducing the effectiveness of the turbine

There are two types of small scale wind turbines available for use, vertical axis and horizontal axis turbines. The conventional horizontal axis turbines are generally more cost effective but are susceptible to problems associated to inner city location and turbulent wind conditions. The new vertical axis turbines are only just becoming commercially available and as such manufacturers are few and costs are high but they are generally more able to cope with certain wind conditions.

Vertical Axis Turbine – XCO2



Horizontal Axis Turbine - Proven



When selecting the type of turbine to be installed a number of factors have to be considered:

6.11.1 Noise and Vibration

6.11.1.1 Aerodynamic Noise

In general, noise from wind turbines comes from two sources: mechanical and aerodynamic. Mechanical noise is not normally a problem with gearless turbines such as the quiet revolution. Aerodynamic noise is generated by turbulent air in the wakes of the turbine blades. The defining factors are the shape of the blade and the speed of the blade tip in relation to the wind speed (tip speed ratio). Modern aerodynamics have resulted in greatly reduced levels of aerodynamic noise from turbines, but the design of vertical axis turbines means they also benefit from reduced tip speed ratio, thus reducing the noise levels even further.

6.11.1.2 Ambient Noise

In many cases, although modern turbines do generate some noise in high wind speeds the noise levels are low when compared with the increases in the background noise produced by the wind through the trees or around buildings. Wind over or around a building can generate significantly more noise than turbines themselves, and any noise they do make is generally lost in the background noise level.

Although documented evidence in relation to generated sound is limited, the available evidence does identify that vertical axis wind turbine (Helical) do generate less sound than the alternative horizontal axis turbines.

6.11.2 Vibration

In general aerodynamic load variation, which induces vibration to a turbine, is reduced by the use of three blades. Adding more blades will reduce this variation further but may increase aerodynamic noise. It is therefore accepted that a three bladed unit is of optimum design. The helical shape blades on the vertical axis turbine also smoothes out any minor fluctuations, creating a turbine which transmits virtually no vibration into the building below.

6.11.3 Wind Speeds

As can be appreciated a major factor in the evaluation of wind turbines is the availability of wind. Investigations have been undertaken to establish the anticipated mean wind speed for the area and this has concluded that at 10m above ground level a mean wind speed in the region of 4.0 - 5.0m/s can be expected. Based on this information (sourced from the Metrological Office) the output of the proposed wind turbines has been based on a mean wind speed of 4.5m/s. It should however be noted that the actual site specific wind speed can only be established by on site measurement once the build is complete, as both the surrounding structures and roof contours will impact on the experienced conditions.

6.11.4 Planning Constraints

A key aspect before the viability of any turbine can be considered is the acceptability of the proposed installation by the local planning authority. Planning Policy Statement (PPS22) sets out a clear national policy framework on renewable energy for planning authorities in England to ensure that the Government's renewable energy targets are met. Under PPS22 regional and Local Planning Authorities should recognise the full range of renewable energy sources, their differing characteristics, locational requirements and the potential for exploiting them subject to appropriate environmental safeguards. PPS22 introduces a new policy area for small systems by encouraging Local Planning Authorities to require that new developments should supply a percentage of their energy needs from onsite renewable energy sources. However wind turbines regardless of size and location still invoke some form of reaction from the surrounding population and this can vary from positive effects such as visually pleasing and an association with environmental conscious approach, through to unsightly and intrusive obstacles which detract from the local environment. In general the vertical axis turbines receive less criticism as they are perceived as a more attractive solution but approval for the proposed design solution would still be required from the Local Planning Authority.

Consideration of small and medium scale wind turbines for the Nicholls site is not considered appropriate due to the surrounding site use, local residents and building use impact.

It has therefore been considered that greater benefit can be gained by investment in other technologies on the site rather than wind generation.

6.12 Combined Heating and Power

Combined heating and power (CHP) is a process involving simultaneous generation of heat and electricity where the heat generated in the process is harnessed by heat recovery equipment for heating, often on a site wide system basis. Conventional electricity generation is 35% efficient with most advanced technologies achieving up to 55%. The remaining 45-65% is lost as waste heat. CHP plants can achieve overall fuel efficiency of up to 90% by generating electricity and recovering heat. In buildings the recovered heat can be used for space heating and domestic water heating.

CHP only save carbon dioxide and money when it is operating. Generally, it is suggested that systems should be running for a minimum of 4,500 hours per year for it to be financially viable.

CHP systems can use various types of plant and fuel including gas turbines. Gas fired CHP is favoured for being clean and enabling a high degree of controllability. Other fields, such as diesel, biodiesel, biomass etc are also available.

The ratio of electricity to heat output from CHP also varies with a type of plant ranging from a 1:1 ratio for diesel engines to as much as 1:3 for some gas fired plant. CHP plant is sized to meet base heat load so that the interaction with on site renewable energy technology has to be considered.

The CHP scheme is considered under the Building Regulations as a zero or low carbon technology. In addition to this heat and power generator of CHP can qualify for a series of other Government initiatives including:

- Exemption from the climate change levy for all good quality CHP fuel inputs and electricity outputs.
- Climate change agreement to provide incentive for emission reductions.
- Eligibility for enhanced capital allowances to stimulate investment.
- Business rates exemption for CHP power generation plant and machinery.

In a similar manner to solar PV the use of micro CHP in this development can be considered and justified against the relatively high electricity use.

CHP has traditionally been selected based on a financial model to justify a reasonable return on investment. The introduction of newer, more efficient, compact machines, has allowed gas fired CHP to be a more feasible option when considering renewables. This is particularly the case where the regulations have tightened up on the carbon emission requirement.

The current design for this project has little requirement for high grade heating so the use of CHP has currently been discounted.

6.13 Biomass

The Biomass Energy Centre defines biomass as “material that is derived from living, or recently living biological organisms” and includes virgin wood, expressly cultivated energy crops, agricultural residues, food waste and specific types of industrial waste and co-products.

Biofuel is “solid, liquid or gaseous fuel that is derived from biomass… that has been processed or converted in some way into a more convenient form, principally to increase energy density”.

The current schemes that use biofuel tend to use either the form of wood chips and pellets (which is considered to be a carbon neutral fuel), or a form of biodiesel based on rapeseed oil. Both of these options require different forms of engines or burners that those that are run from just gas or diesel and therefore have a higher capital cost. In addition the amount and type of storage required for the fuels may require large wood chip stores on site or fuel tanks. Some devices are also able to be run on two different sources e.g. gas and biodiesel.

The use of biomass is normally related to the main boilers for a development and for a small scale building such as this, it is considered infeasible.

6.14 Ground Source Heating and Cooling

Ground source heating and cooling uses relatively stable low temperature of the ground or bodies of water as a source for providing heating and cooling in buildings. There are different systems available including open loop and closed loop ground and water based systems.

The most common system is ground source heating and cooling using ground source heat pumps. Ground source heat pumps can be used to serve more than one building when linked to a community heating scheme. When considering ground source heating and cooling, the principle

factor is the suitability of the ground as a heat exchanger. This needs to be considered at early stages in the design process and the considerations will include:

- The available land per horizontal ground loop.
- Potential load temperature uses within the buildings.
- Geotechnical assessments for boreholes including hydrogeological survey information for existing boreholes if these exist.
- Consent from the Environment Agency for open loop boreholes.

Ground water temperatures are not guaranteed and appropriate tests would need to be taken at an early stage.

Heat pumps use the refrigeration cycle to transfer heat between a relatively cold source and a relatively hot source. Heat pumps can be used to provide either cooling or heating.

A ground source heat pump uses the ground as a source of heat and the building water circuit as the sink. The attraction of the ground to the heat source for ground source heat pumps is based on the assumption that beyond a certain depth (around 10m) ground temperatures stay effectively constant at approximately average air temperature, circa 10-14◦C in the UK.

There is still some debate about the status of heat pumps as renewable technology as they use grid electricity, however, ground source heat pumps are considered a renewable technology in many of the renewables tool kits, particularly the GLS tool kit.

While heat pumps are regarded as renewable in principle, the more general concern is whether they reduce carbon emissions relative to alternative options per heating and, if so, by how much. Gas (the most common alternative heating fuel) has lower CO_2 emissions per kwh delivered than electricity. Ground source heat pumps used for heating can reduce CO_2 emissions as long as the seasonal CHP is higher than the ratio of electricity to gas CO_2 emission factors.

For this development it is considered that ground source heat pumps may prove to be a less financial viable option than alternatives such as the CHP plant and the savings in carbon made would be disproportionate to the overall investment cost.

There are also considerable issues with creating ground loops or bole holes without disturbing tree rooting systems, car parking etc and on this basis, GSHP has been dismissed at this stage.

6.15 Heat Recovery

The use of heat recovery systems can results in lower running costs and possibly reduced plant capacities. These systems most commonly recover heat from ventilation systems, using devices such as heat wheels or run-around coils to recover energy from exhaust air, then use it to pre-heat or pre-cool supply air. There must be sufficient energy being rejected at times when it can be used to justify the added complications and running costs of the installing heat recovery devices.

6.16 Minimising Distribution Losses

The location of the plant areas within the development have been reviewed to ensure that the siting of pumps and fans are at their optimum location in terms of the loads that they are supplying to reduce transport losses as far as possible within the building form and function. The systems within the development will also be carefully sized and routed in a manner that keeps systems pressure drops down to a minimum which will contribute to ensuring that as little energy is used as possible.

6.17 Manageability, Commissionability, Maintainability and Flexibility

The systems within the development will be designed to ensure that they are easy to use and manage ensuring that they achieve their full potential for energy saving e.g. systems will ideally default to off or standby.

The requirements of the services as regards space, position, access, repair and replacement will be considered during the design to ensure that the systems can be commissioned and maintained effectively which will assist to ensure that the systems are used as efficiently as possible throughout their lifetime.

The design of the services will also take account of potential future changes in the systems to ensure that systems are not made redundant in the future and can be flexible in the future e.g. additional space can be allowed within systems or plant areas for possible changes / extensions.

6.18 Metering

A metering strategy will be developed to ensure that the future building performance can be continually monitored by the building operator. This will require the inclusion of meters and sub-meters within the mechanical and electrical services systems and may require a centralised system fir monitoring and reporting. The strategy will comply with the current building regulations requirements.

APPENDIX A

Initial Thermal Modelling Output Results

1.0 EXECUTIVE SUMMARY

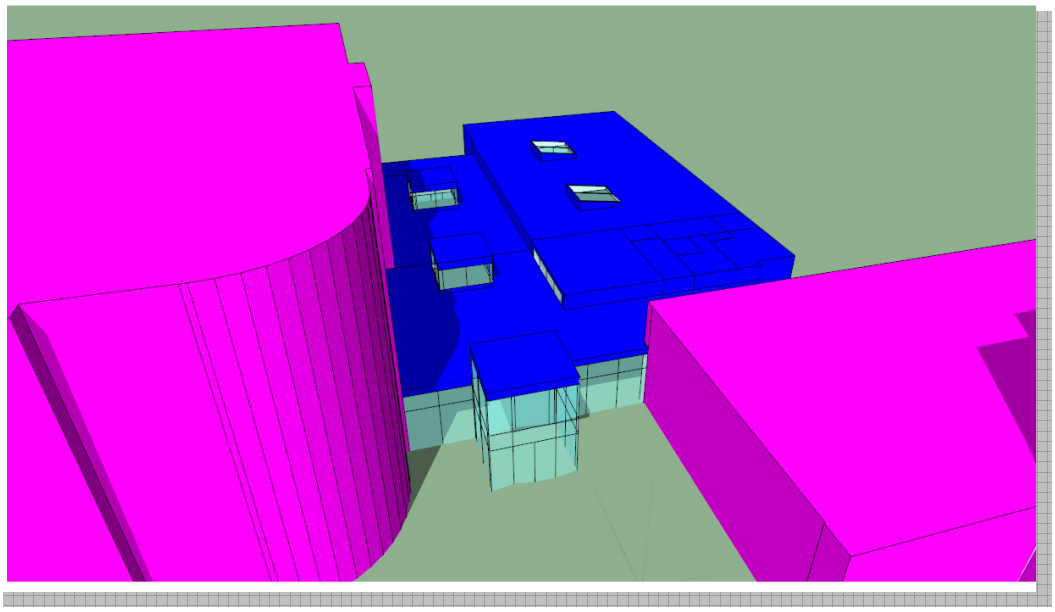


Figure 1 – 3D Image of 'Actual' Building

ADL2A: 2010	
Criterion 1	PASS
Criterion 2	PASS
Criterion 3	PASS

Table 1 – Results Summary

This report contains the results of the SBEM (Simplified Building Energy Model) assessment that shows this building 'as-designed' is compliant with the 2010 Approved Document Part L2A Criterion 1, Criterion 2, and Criterion 3. For full details, please refer to the BRUKL document included in this report.

A preliminary EPC with a provisional asset rating of 23, corresponding to an 'A' is included as an appendix to this report, it has been produced based on design information provided and using the version of the EPC calculation engine at the time of the assessment, and is provided as an indicative result only.

Environmental Services Design is bound by certification rules over the version of EPC calculation engine used at the time of final certification (on project completion) and is not liable for any changes in final rating (from preliminary) which result from changes to final 'as built' specification or EPC calculation engine.

2.0 ADL2A:2010 BUILDING REGULATIONS SUMMARY

As of 1st October 2010 the Building Regulations Approved Document Part L: 2006 has been superseded by Approved Document Part L: 2010 Part L for all projects commencing after this date. The new Part L largely follows the same methodology as before with a number of key changes designed to reduce energy use and carbon emissions of buildings. Efforts have been made to discourage designers and developers from achieving compliance by simply bolting on renewable technologies onto inherently inefficient buildings. The intention is that this will lead to a more holistic approach to design.

One of the key changes is to the way in which the Target Emissions Rate (TER) value is calculated from the Notional building. Instead of applying Improvement and LZC factors to the Notional building to determine the TER, the 2010 Notional building represents an aggregate 25% improvement on the 2006 regulations and now forms the TER directly.

Another key change is to Criterion 3, which under the 2006 regulations required demonstration that there was no excessive risk of overheating in buildings that were not air-conditioned. Under the 2010 regulations, Criterion 3 no longer considers overheating, instead it requires evidence that the cumulative, summertime summer solar gains do not exceed fixed benchmark values. This applies to all occupied or mechanically cooled spaces irrespective of the buildings systems types.

In addition to these key changes the regulations have improved system performance criteria. This includes the addition of daylight control in certain room types in the Notional building which will mean that higher performance lighting designs may be required.

In order to carry out an SBEM compliance analysis a 3D model (Figure 1) was created using approved Integrated Environmental Solutions Virtual Environment (IES-VE) software version 6.4.0.10 Model geometry was built from Architectural drawings received from Walker Simpson Architects and preliminary HVAC specifications have been provided by Environmental Services Design. The Notional building (Figure 2) was generated by the software to be the same size and shape as the Actual building with fabric, fixed building services and windows as set out in the National Calculation Methodology (NCM) guidance document.

Section 3.0 of this report summarises how this building performed against Criteria 1, 2 and 3 under the 2010 regulations.

3.0 COMPLIANCE CHECK

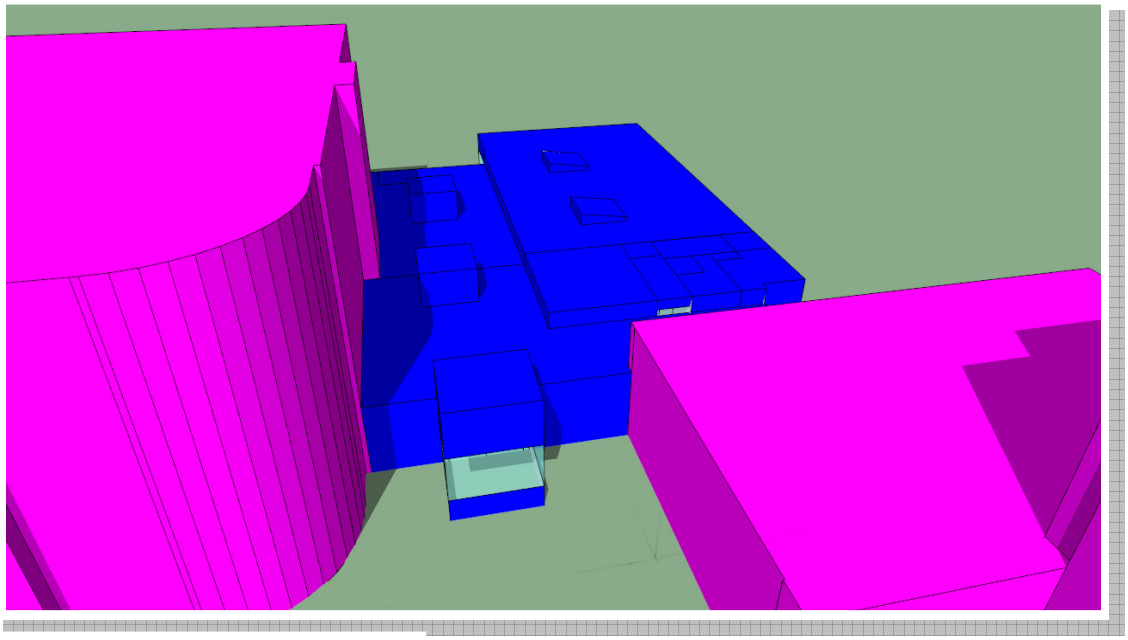


Figure 2 – 3D Image of 'Notional' Building

3.1 Criterion 1

This building has demonstrated compliance with Criterion 1 of the 2010 Building Regulations Part L2A by achieving a simulated BER less than the TER.

Target Emissions Rate (TER)	**38.4 kg.CO_2/m^2/yr.**
Building Emissions Rate (BER)	**28.8 kg.CO_2/m^2/yr.**

Table 2 – Results Summary

3.2 Criterion 2

Building fabric and systems performance have been checked against the limits as set out in the 2010 Non-domestic Compliance Guide. This assessment demonstrates that the building (as-designed) complies with the requirements of Criterion 2.

Table 3 on the next page gives a summary of the design limits and the building specification used for the DSM compliance analysis.

Element / System		Limits 2010 Regs	2010 Notional	As Designed Specification
Area Weighted U-Value (W/m^2K)	External Wall	0.35	0.26	0.26
	Exposed Floor	0.25	0.22	0.22
	Exposed Roof	0.25	0.18	0.18
	Window / Rooflight	2.2	1.8	1.8
	Personnel doors	2.2	2.2	1.80
Glass Properties	Side-lit light transmittance (A)	-	0.71	0.71
	Side-lit solar transmittance (g-value) (A)	-	0.68	0.295
	Side-lit light transmittance (B)	-	0.71	0.71
	Side-lit solar transmittance (g-value) (B)	-	0.68	0.4
	Top-lit light transmittance	-	0.67	0.67
	Top-lit solar transmittance (g-value)	-	0.46	0.44
Air tightness ($m^3/(h.m^2)$ @ 50 Pa		10	5	5
Lighting Efficiency & Controls		55 lm/circuit W	55 lm/circuit W & some daylight control	See separate table in Appendix A

Heating / Cooling - System 1 - Bi-Valent System - ASHP w/ Underfloor + Radiators (50/50) - Natural Ventilation				
NCM Type	Central heating using water: Floor heating			
Heating Boiler	ASHP Seasonal efficiency SCoP	2.00	2.56	3.29
	Fuel	Grid Supplied Electricity		
	Variable speed sensor across pump	n/a	No	Yes
Cooling	Type	Natural Ventilation		
	Fan SFP & Flow rates	n/a		
Metered	Yes	Out of range metering		Yes
Heat Recovery	No	Heat recovery efficiency		n/a

Heating / Cooling - System 2 - Bi-Valent System - ASHP w/ Underfloor + Radiators (50/50) - Mech Vent				
NCM Type	Central heating using water: Floor heating			
Heating Boiler	ASHP Seasonal efficiency SCoP	2.00	2.56	3.29
	Fuel	Grid Supplied Electricity		
	Variable speed sensor across pump	n/a	No	Yes
Cooling	Type	Mechanical Ventilation		
	Fan SFP & Flow rates	See separate table		
Metered	Yes	Out of range metering		Yes
Heat Recovery	Yes	Heat recovery efficiency		75%

Hot water - System 1 - ASHP w/ No Storage				
NCM Type	Central heating using water: Radiators			
DHW (Heating) Boiler	Natural Gas Seasonal efficiency SCoP	2.00	2.56	3.29
	Fuel	Grid Supplied Electricity		
	Variable speed sensor across pump	n/a	no	Yes
	DHW delivery efficiency	n/a	95.0%	100%
	Storage	n/a	0 litres	0 litres

Adjustment for management features (ADL2A Table 2)		
Electric power factor correction	Yes	>0.95
Lighting systems have provision for metering	Yes	
Lighting systems metering warns of 'out-of-range' values	Yes	

= Better than Notional
= Worse than Notional but better than limit
= Worse than limit

Table 3 – Results Summary

Mechanical Supply & Extract has been added to the room types listed in Table 4 below.

Room Name	Supply	Extract	Heat recovery	Supply SFP (W/l/s)	Extract SFP (W/l/s)
Rm 07 Office	4ACH	-	75%	1.2	-
Rm 09 Toilet	-	10 ACH	-	-	0.6
Rm 10 Toilet	-	10 ACH	-	-	0.6
Rm 11 Toilet	-	10 ACH	-	-	0.6

Table 4 – Ventilation Performance

Fixed internal lighting and controls have been included within the model on a room type basis as per the following table (Table 5)

Room	Power Density W/m² per 100 Lux	Control
Rm 01 Circulation	5.00	Auto on/off
Rm 02 Reception/Waiting	2.50	Manual on/off
Rm 02 Servery	1.00	Manual on/off
Rm 3 Circulation	5.00	Auto on/off
Rm 04 Refectory	3.30	Manual on/off
Rm 07 Office	1.25	Auto on/off
Rm 08 Circulation	5.00	Auto on/off
Rm 09 Circulation	5.00	Auto on/off
Rm 09 Toilet	2.50	Auto on/off
Rm 10 Circulation	5.00	Auto on/off
Rm 10 Toilet	2.50	Auto on/off
Rm 11 Toilet	2.50	Auto on/off
Rm 12 Store	10.00	Auto on/off
Rm 13 Store	10.00	Auto on/off

Table 5 – Fixed Internal Lighting Performance

3.3 Criterion 3

Criterion 3 states that the aggregated solar gains through the building fabric received by all occupied or, mechanically cooled spaces during the period from April to September must not exceed the regulatory benchmark. The results of this assessment demonstrate that the solar gain is within the required limits for all areas and has therefore successfully complied with Criterion 3.

Further details relating to Criterion 3 are included within the BRUKL document.

4.0 RENEWABLE TECHNOLOGIES

4.1 Solar PV

Photovoltaic Specification	
PV Array Type	Monocrystalline Silicon
PV Module Nominal Efficiency	0.13
Nominal Cell Temperature (NOCT) (°C)	45.0
Reference Irradiance for NOCT (W/m²)	800
Temperature Coefficient for Module Efficiency (1/K)	0.004
Degradation Factor	0.99
Shading Factor	1.0
Electrical Conversion Efficiency	0.85
Photovoltaic Panels	
Area (m²)	55.0
Azimuth (° clockwise from north)	180
Inclination (° from horizontal)	40.0

Table 6 – Solar PV Specification

4.2 Solar PV Contribution

Currently 55m² of Photovoltaic panels have been incorporated which produce electricity on site. BREEAM points are available alongside a renewable energy feasibility (ENE7) report if 15% of the buildings total energy use is provided by onsite low or zero carbon technologies. Table 7 below shows the 15 % target taken from the total onsite energy demand and the actual contribution from the Photovoltaic Panels. It has been demonstrated that the contribution is currently 13.58% of the total site energy which could be increased to reach the 15% target if required.

	kWh/m².yr
Total Site Energy Demand	64.64
15% of Site Energy Demand	9.69
Solar PV Contribution	8.78

Table 7 – Solar PV Contribution

5.0 CONCLUSIONS & RECOMMENDATIONS

Currently the building 'As Designed' is achieving a 25% improvement over current Part L2A 2010 Criterion 1 building regulations by showing a Building Emission Rate significantly below the Target Emission Rate.

This improvement has been achieved through taking a holistic approach to reducing building emissions. Figure 3 demonstrates this by showing an expected distribution of CO_2 emissions across lighting, hot water, auxiliary vent and heating.

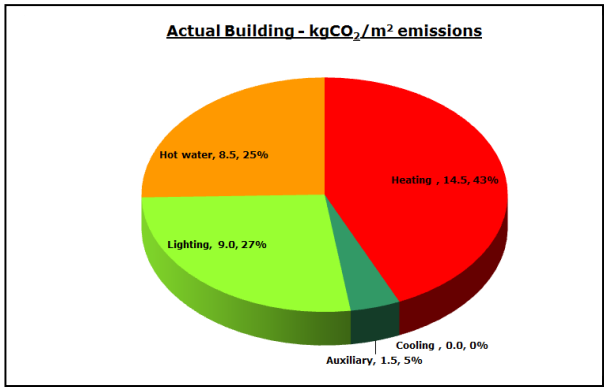


Figure 3 – Actual CO_2 emissions by end use

Figure 4 shows how the actual building has compared against the notional building which is used to create the Target Emission Rate.

Low U-values combined with a high efficiency Air Source Heat Pump to provide heating via a mix of under floor and radiators improved upon the heating levels set within the notional building.

Hot water is also provided from an ASHP allowing for higher efficiencies than a standard water boiler and therefore also improves upon the notional target.

Primarily natural ventilation has been adopted throughout the development with only a small amount supply and extract incorporated. This supply and extract system also allows for heat recovery and although slightly worse than the notional building but it is a very small source of emissions.

Low energy lighting has been adopted with PIR sensors to storage areas, circulation spaces and toilets to slightly improve upon the notional building.

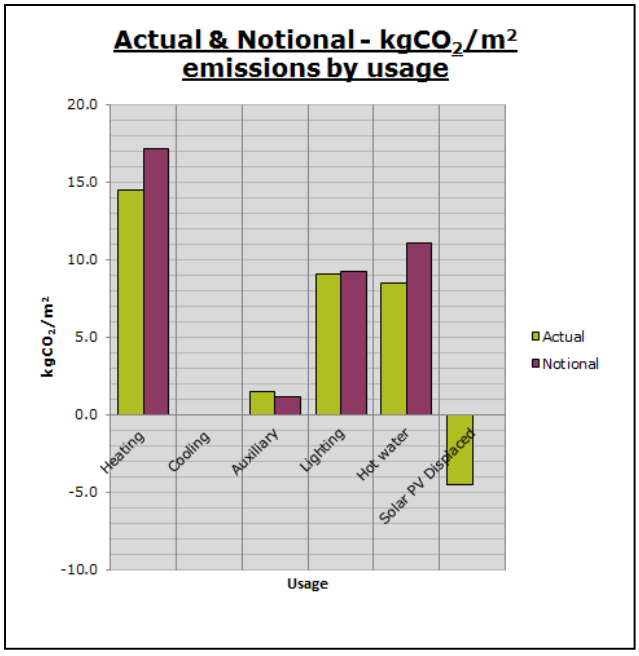


Figure 4 – Actual vs. Notional CO_2 emissions by end use

Before the use of any renewable technologies the current building 'As Designed' was compliant with ADL2A Criterion 1 by 12.8%. A target improvement of 25% was set to be able to achieve a BREEAM 'Excellent' under ENE1 (Reduction of CO_2 Emissions).

The use of Solar PV has been incorporated to achieve the further 12.2% improvement required, this demonstrates that the use of renewable technologies have been used at the last stage to achieve a very difficult target and have not simply been used to improve an inherently inefficient building.

BRUKL Output Document

HM Government

Compliance with England and Wales Building Regulations Part L 2010

Project name

EJ328 S1 V2012 Nicholls Campus Link Building 08-08-12

As designed

Date: Fri Aug 10 11:13:49 2012

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: Apache

Calculation engine version: 6.4.0.10

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 6.4.0.10

BRUKL compliance check version: v4.1.d.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Environmental Services Design

Telephone number:

Address: , ,

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, $kgCO_2/m^2.annum$	38.4
1.2	Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	38.4
1.3	Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	28.8
1.4	Are emissions from the building less than or equal to the target?	BER =< TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

2.a Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	D1090010:Surf[12]
Floor	0.25	0.22	0.22	D1090010:Surf[0]
Roof	0.25	0.18	0.18	D1090010:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.8	1.8	D1090022:Surf[2]
Personnel doors	2.2	2.2	2.2	D1090022:Surf[10]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

2.b Building services

The building services parameters listed below are expected to be checked by the BCO against guidance. No automatic checking is performed by the tool.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Bi-ValentSystem-ASHP Underfloor + Rads 50/50 Natural Vent

Heating seasonal efficiency	**Cooling nominal efficiency**	**SFP [W/(l/s)]**	**HR seasonal efficiency**
3.5	-	0	-
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

2- Bi-ValentSystem- ASHP Underfloor + Rads 50/50 Supply & Extract w/ Heat Recovery

Heating seasonal efficiency	**Cooling nominal efficiency**	**SFP [W/(l/s)]**	**HR seasonal efficiency**
3.5	-	0	0.75
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

1- DHW - ASHP

Heating seasonal efficiency	**Hot water storage loss factor [kWh/litre per day]**
3.5	-

Local mechanical ventilation and exhaust

Zone	**Supply/extract SFP [W/(l/s)]**	**HR seasonal efficiency**	**Exhaust SFP [W/(l/s)]**
Rm 07 Office	1.2	-	1.2
Rm 09 Toilet	-	-	0.6
Rm 10 Toilet	-	-	0.6
Rm 11 Toilet	-	-	0.6

General lighting and display lighting

Zone	**General lighting [W]**	**Display lamps efficacy [lm/W]**
Rm 01 Circulation	60	-
Rm 02 Reception/Waiting	660	22
Rm 02 Servery	630	-
Rm 03 Circulation	40	-
Rm 04 Refectory	1390	-
Rm 07 Office	160	-
Rm 08 Circulation	40	-
Rm 09 Circulation	10	-
Rm 09 Toilet	40	-
Rm 10 Circulation	10	-
Rm 10 Toilet	40	-
Rm 11 Toilet	20	-
Rm 12 Store	10	-
Rm 13 Store	60	-

Criterion 3: The spaces in the building should have propriate passive control measures to limit solar gains

Zone	**Solar gain limit exceeded? (%)**	**Internal blinds used?**
Rm 02 Reception/Waiting	NO (-0.4%)	NO
Rm 04 Refectory	NO (-19.5%)	NO
Rm 07 Office	NO (-93.5%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	633.9	633.9
External area [m^2]	1675	1675
Weather	MAN	MAN
Infiltration [m^3/hm^2@ 50Pa]	5	5
Average conductance [W/K]	714.72	548.83
Average U-value [W/m^2K]	0.43	0.33
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
100	**C2 Residential Inst.: Universities and colleges**
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Telephone exchanges
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

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

	Actual	Notional
Heating	28.09	32.94
Cooling	0	0
Auxiliary	2.86	2.21
Lighting	17.25	17.74
Hot water	16.44	21.31
Equipment*	72.44	72.44
TOTAL	**64.64**	**74.19**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	8.78	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Indicative Target
Heating + cooling demand [MJ/m^2]	332.46	303.31
Total consumption [kWh/m^2]	64.64	74.19
Total emissions [kg/m^2]	28.8	38.4

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: floor heating, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	339.4	0	28.7	0	1.4	3.29	0	3.5	0
	Notional	307.8	0	33.4	0	1.4	2.56	0	----	----
[ST] Central heating using water: floor heating, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	203	0	17.2	0	29.2	3.29	0	3.5	0
	Notional	221	0	24	0	16.5	2.56	0	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	D1090010:Surf[12]
Floor	0.2	0.22	D1090010:Surf[0]
Roof	0.15	0.18	D1090010:Surf[1]
Windows, roof windows, and rooflights	1.5	1.8	D1090010:Surf[2]
Personnel doors	1.5	2.2	D1090022:Surf[10]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5

Energy Performance Certificate

Non-Domestic Building

HM Government

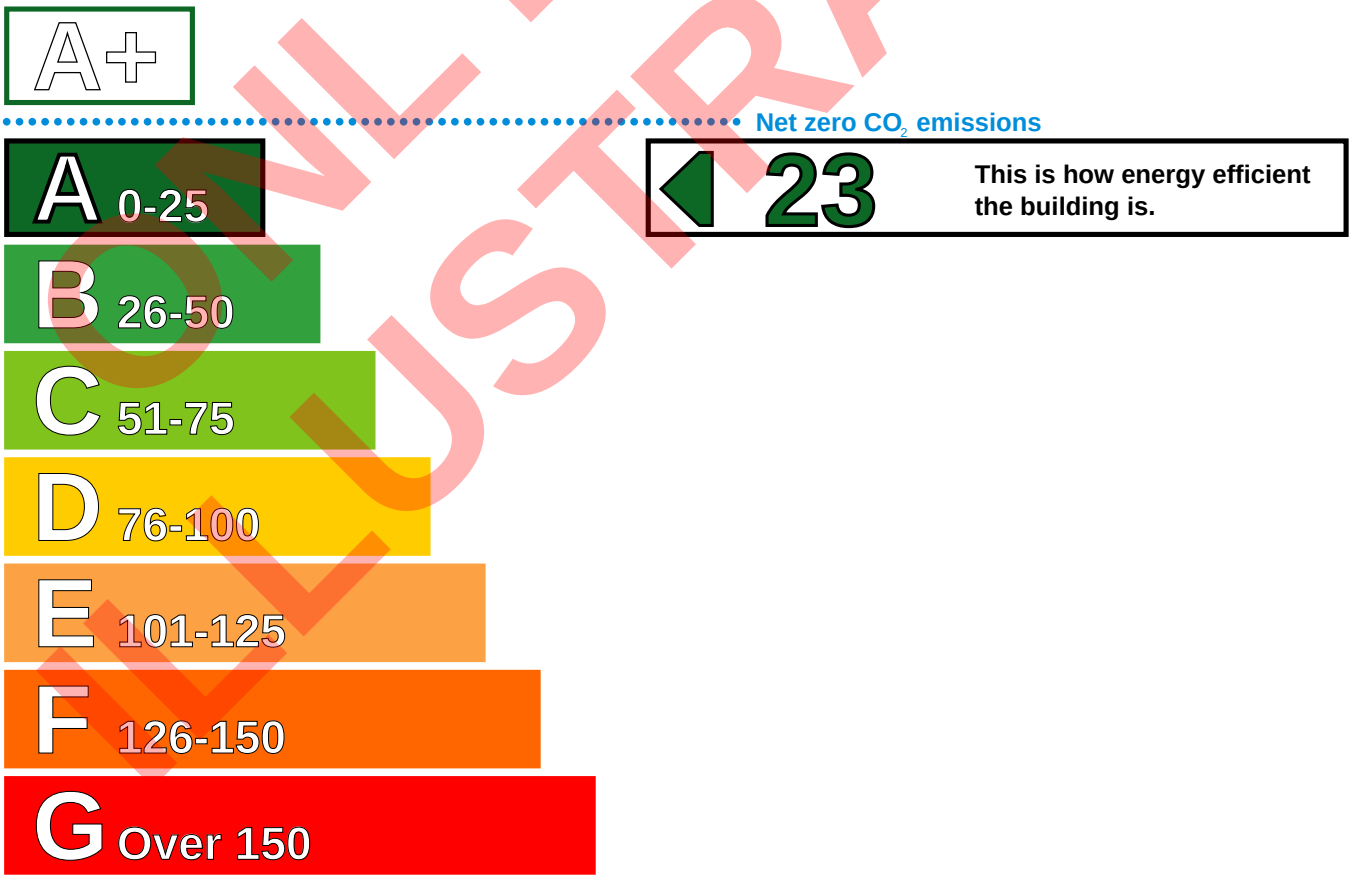
EJ328 S1 V2012 Nicholls Campus Link Building 08-08-12

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



Less energy efficient

Technical information

Main heating fuel:	District Heating
Building environment:	Heating and Natural Ventilation
Total useful floor area (m^2):	633.940
Building complexity (NOS level):	5
Building emission rate ($kgCO_2/m^2$):	28.78

Benchmarks

Buildings similar to this one could have ratings as follows:

30 If newly built

81 If typical of the existing stock

ONLY FOR ILLUSTRATION

Administrative information

This is an Energy Performance Certificate as defined in SI2007:991 as amended

Assessment Software:	Virtual Environment v6.4.0 using calculation engine ApacheSim v6.4.0
Property Reference:	000000000000
Assessor Name:	Environmental Services Design
Assessor Number:	STRO007864
Accreditation Scheme:	Stroma Accreditation Ltd
Employer/Trading Name:	Trading Name
Employer/Trading Address:	Trading Address
Issue Date:	10 Aug 2012
Valid Until:	09 Aug 2022 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the property are contained in Report Reference Number: 0040-0000-0408-0900-0004

If you have a complaint or wish to confirm that the certificate is genuine

Details of the assessor and the relevant accreditation scheme are on the certificate. You can get contact details of the accreditation scheme from the Government's website at www.communities.gov.uk/epbd, together with details of the procedures for confirming authenticity of a certificate and for making a complaint.

ONLY FOR ILLUSTRATION

CARBON TRUST

For advice on how to take action and to find out about technical and financial assistance schemes to help make buildings more energy efficient visit **www.carbontrust.co.uk** or call us on **0800 085 2005**

APPENDIX B

Initial BREEAM Pre-Assessment

BREEAM 2011 New Construction Pre-Assessment Estimator

This assessment and indicative BREEAM rating is not a formal certified BREEAM assessment or rating and must not be communicated as such. The score presented is indicative of a buildings potential performance and is based on a simplified pre-formal BREEAM assessment and unverified commitments given at an early stage in the design process.

Building name	Nicholls Campus - Link Building
Indicative building score (%)	74.71%
Indicative BREEAM rating	Pre-Assessment result indicates potential for BREEAM Excellent rating
Indicative minimum standards level achieved	Pre-Assessment result indicates the minimum standards for Excellent level

MANAGEMENT — Section Weighting 12.00% — Indicative Section Score 9.82%

Man01 Sustainable Procurement

No. of BREEAM credits available	8	Available contribution to overall score	4.36%
No. of BREEAM innovation credits available	1	Minimum standards applicable	Yes

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will roles, responsibilities and a training schedule be defined in accordance with BREEAM?	Yes	1	1
Will a BREEAM AP be appointed at RIBA stage A/B and performance targets contractually agreed?	Yes	1	1
Will a BREEAM AP be appointed to monitor and report progress during RIBA stage B-E ?	Yes	1	1
Willa BREEAM AP be appointed to monitor and report progress during RIBA stage F-L?	Yes	1	1
Will a thermographic survey be conducted and any defects uncovered remedied?	Yes	1	1
Will compliant commissioning of building services be carried out?	Yes	1	1
Will compliant seasonal commissioning of building services be carried out?	Yes	1	1
Will water/energy consumption data be recorded and aftercare support provided for 12 months?	Yes	1	1
Will water/energy consumption be recorded/reported for 3 years post construction?	Yes	1	1

Total indicative BREEAM credits achieved	8
Total indicative contribution to overall building score	4.36%
Total indicative BREEAM innovation credits achieved	1
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Man02 Responsible Construction Practices

No. of BREEAM credits available	2	Available contribution to overall score	1.09%
No. of BREEAM innovation credits available	1	Minimum standards applicable	Yes

Pre-Assessment question/criteria	
Which considerate construction scheme will be used or required to be used by the principal contractor?	Considerate Constructors Scheme
For the required scheme, what will be the target performance level set for the site/contractor?	A CCS score of 36 or more

Total indicative BREEAM credits achieved	2
Total indicative contribution to overall building score	1.09%
Total indicative BREEAM innovation credits achieved	1
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Man03 Construction Site Impacts

No. of BREEAM credits available	5	Available contribution to overall score	2.73%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will site energy consumption be metered/monitored?	Yes	1	1
Will site water consumption be metered/monitored?	Yes	1	1
Will the transport of construction materials and waste to/from site be measured/monitored?	Yes	1	1
Will timber be sourced in accordance with the Government's Timber Procurement Policy?	Yes	1	1
Will/does the principal contractor operate a compliant Environmental Management System?	Yes	1	1
Will the principal contractor adopt best practice pollution prevention policies & procedures?	Yes		

Total indicative BREEAM credits achieved	5

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Total indicative contribution to overall building score	2.73%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Man04 Stakeholder Participation

No. of BREEAM credits available	4	Available contribution to overall score	2.18%
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will an appropriate level of consultation activities be undertaken?	No	1	0
Will an access statement be developed and appropriate building user facilities provided?	Yes	1	1
Will building user guides and relevant user information be provided?	Yes	1	1
Will a post occupancy evaluation assessment be undertaken and information disseminated?	Yes	1	1

Total indicative BREEAM credits achieved	3
Total indicative contribution to overall building score	1.64%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Consultation methods need to be carried out by third party, e.g. DQI.

Man05 Life cycle cost and service life planning

No. of BREEAM credits available	3	Available contribution to overall score	1.64%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will a feasibility stage Life Cycle Cost (LCC) analysis be commissioned and completed?	No	1	0
Will a strategic and system level LCC be commissioned and completed?	No	1	0
Will a technical design LCC to be commissioned and completed?	No	1	0

Total indicative BREEAM credits achieved	0
Total indicative contribution to overall building score	0.00%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

HEALTH & WELLBEING — Section Weighting: 15.00% — Indicative Section Score: 12.86%

Hea01 Visual Comfort

No. of BREEAM credits available	3	Available contribution to overall score	3.21%
No. of BREEAM innovation credits available	1	Minimum standards applicable	Yes

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will all fluorescent lamps be fitted with high frequency ballasts?	Yes	N/A	N/A
Will all relevant building areas be designed to achieve the appropriate daylight factor(s)?	Yes	1	1
Will the design provide adequate glare control and view out for building users?	Yes	1	1
Will internal/external lighting be specified in accordance with the relevant CIBSE Guides/British Standards?	Yes	1	1

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Will all relevant building areas be designed to achieve exemplary level daylight factor(s)?	No	1	0

Total indicative BREEAM credits achieved	3
Total indicative contribution to overall building score	3.21%
Total indicative BREEAM innovation credits achieved	0
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Hea02 Indoor Air Quality

No. of BREEAM credits available	4	Available contribution to overall score	4.29%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will an air quality plan be produced?	Yes	1	1
Will the building be designed to minimise sources of internal air pollution?	Yes		
Will the relevant products be specified to meet the VOC testing and emission levels required?	Yes	1	1
Will formaldehyde and total VOC levels be measured post construction?	No	1	0
Will the building be designed to, or have the potential to provide, natural ventilation?	Yes	1	1

Total indicative BREEAM credits achieved	3
Total indicative contribution to overall building score	3.21%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Needs an Indoor Air Quality Plan as a minimum to achieve credits here. This must include consideration of: 1) Removal of contaminant sources, 2) Dilution and control of contaminant sources, 3) Procedures for pre-occupancy flush out, 4) 3rd party testing and analysis. - Also: air conditioning intakes and extracts 10m apart and 20m from external pollution, OR natural ventilaiton openings are 10m from external pollution sources. AND have CO2 monitor sensors installed.

Hea03 Thermal Comfort

No. of BREEAM credits available	2	Available contribution to overall score	2.14%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will thermal modelling of the design be carried out?	Yes	1	1
Will the modelling inform the development of a thermal zoning and control strategy?	Yes	1	1

Total indicative BREEAM credits achieved	2
Total indicative contribution to overall building score	2.14%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Hea04 Water Quality

No. of BREEAM credits available	1	Available contribution to overall score	1.07%
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will all water systems be designed to comply with the relevant HSE Approved Code of Practice and Guidance?	Yes	1	1
Where humidification is to be provided, will a failsafe humidification system be specified?	Yes		
Will a wholesome supply of accessible, clean and fresh drinking water be supplied for building users?	Yes		

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Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	1.07%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Hea05 Acoustic Performance

No. of BREEAM credits available	2	Available contribution to overall score	2.14%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will/has a suitably qualified acoustician be appointed to provide appropriate design advice?	Yes		
Will the building meet the relevant acoustic performance standards and testing requirements?	Yes	2	1

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	1.07%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Achieve BB93,

Hea06 Safety and Security

No. of BREEAM credits available	2	Available contribution to overall score	2.14%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Where external site areas are present, will safe access be designed for pedestrians and cyclists?	Yes	1	1
Will a suitably qualified security consultant be appointed and security considerations accounted for?	Yes	1	1

Total indicative BREEAM credits achieved	2
Total indicative contribution to overall building score	2.14%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

ENERGY — Section Weighting: 19.00% — Indicative Section Score: 9.12%

Ene01 Reduction of CO_2 Emissions

No. of BREEAM credits available	15	Available contribution to overall score	11.40%
No. of BREEAM innovation credits available	5	Minimum standards applicable	Yes

How do you wish to assess the number of BREEAM credits achieved for this issue?	Define a target number of BREEAM credits achieved		
Select the target number of BREEAM credits for the Ene01 issue	6	BREEAM Innovation credits	

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Total indicative BREEAM credits achieved	6
Total indicative contribution to overall building score	4.56%
Total indicative BREEAM innovation credits achieved	0
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Excellent level

Comments/notes:

Calculation takes into account 3 issues, not just carbon emissions. These are 1) Energy Demand, 2) Energy Consumption, 3) Emission Rate. However does still require a minimum CO2 emission rate improvement on the TER of 25%.

Ene02 Energy Monitoring

No. of BREEAM credits available	2	Available contribution to overall score	1.52%
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will a BMS or sub-meters be specified to monitor energy use from major building services systems?	Yes	1	1
Will a BMS or sub-meters be specified to monitor energy use by tenant/building function areas?	Yes	1	1

Total indicative BREEAM credits achieved	2
Total indicative contribution to overall building score	1.52%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Ene03 External Lighting

No. of BREEAM credits available	1	Available contribution to overall score	0.76%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will external light fittings and controls be specified in accordance with the BREEAM criteria?	Yes	1	1

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	0.76%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

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Ene04 Low and Zero Carbon Technology

No. of BREEAM credits available	5	Available contribution to overall score	3.80%
No. of BREEAM innovation credits available	1	Minimum standards applicable	Yes

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Compliant LZC feasibility study to be undertaken	Yes	2	1
What will be the intended scope of the feasibility study?	Operational stage carbon savings/emissions		
Target percentage net reduction in operational stage CO2 emissions	5.00%	2	0
Please confirm the intended energy source of the Low and/or zero carbon system?	Solar		
Building is cooled mechanically, not utilising 'free' cooling	No	1	0

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	0.76%
Total indicative BREEAM innovation credits achieved	0
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Ene05 Energy Efficient Cold Storage

Assessment Issue Not Applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved

Total indicative BREEAM credits achieved	N/A
Total indicative contribution to overall building score	N/A
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Ene06 Energy Efficient Transportation Systems

Assessment Issue Not Applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved

Total indicative BREEAM credits achieved	N/A
Total indicative contribution to overall building score	N/A
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

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Ene07 Energy Efficient Laboratory Systems

Assessment Issue Not Applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved

Total indicative BREEAM credits achieved	N/A
Total indicative contribution to overall building score	N/A
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Ene08 Energy Efficient Equipment

No. of BREEAM credits available	2	Available contribution to overall score	1.52%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Present	Significant majority contributor
Which of the following will be present and likely to be a/the major contributor to 'unregulated' energy use:		
Small power/plug in equipment?	Yes	Yes
Swimming pool?	No	
Communal laundry?	No	
Data centre?	No	
IT-intensive operation areas?	No	
Residential areas?	No	
Healthcare?	No	
Kitchen and catering facilities?	Yes	Yes

	Indicative compliance?	Credits available	Indicative credits achieved	
Will the significant majority contributor(s) to 'unregulated' energy use (above) meet the BREEAM criteria?	Yes	2	2	N/A

Total indicative BREEAM credits achieved	2
Total indicative contribution to overall building score	1.52%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Ene09 Drying Space

Assessment Issue Not Applicable

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No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved

Total indicative BREEAM credits achieved	N/A
Total indicative contribution to overall building score	N/A
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

TRANSPORT — Section Weighting: 8.00% — Indicative Section Score: 3.64%

Tra01 Public Transport Accessibility

No. of BREEAM credits available	5	Available contribution to overall score	3.64%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria

What is the building type category (for the purpose of Tra01 issue assessment)?	Further Education/Vocational College
What is the degree of public transport provision for the building's location?	Very Good provision of public transport i.e. small/medium urban centre
Building's indicative Accessibility Index	10
Does the building have a dedicated bus service?	

Total indicative BREEAM credits achieved	3
Total indicative contribution to overall building score	2.18%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Tra02 Proximity to Amenities

No. of BREEAM credits available	1	Available contribution to overall score	0.73%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will the building be in close proximity of and accessible to applicable amenities?	Yes	1	1

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	0.73%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Tra03 Cyclist facilities

No. of BREEAM credits available	2	Available contribution to overall score	1.45%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

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What is the building type category (for the purpose of Tra03 issue assessment)?	Further & Higher Education

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will cycle storage spaces be provided?	No	2	0
Will cyclist facilities be provided?	No		

Total indicative BREEAM credits achieved	0
Total indicative contribution to overall building score	0.00%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Tra04 Maximum Car Parking Capacity

No. of BREEAM credits available	2	Available contribution to overall score	1.45%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Building type category (for the purpose of Tra04 issue)?	Further & Higher Education
Buildings indicative Accessibility Index (sourced from issue Tra01)	10

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will the building meet BREEAM's maximum parking capacity criteria for this building type/Accessibility Index?	No	2	0

Total indicative BREEAM credits achieved	0
Total indicative contribution to overall building score	0.00%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Tra05 Travel Plan

No. of BREEAM credits available	1	Available contribution to overall score	0.73%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will a transport plan based on site specific travel survey/assessment be developed?	Yes	1	1

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	0.73%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

WATER — Section Weighting: 6.00% — Indicative Section Score: 4.67%

Wat01 Water Consumption

No. of BREEAM credits available	5	Available contribution to overall score	3.33%

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No. of BREEAM innovation credits available	1	Minimum standards applicable	Yes

Select the level that corresponds closely to the target or likely water component specification?	Level 3 - Three credits

Total indicative BREEAM credits achieved	3
Total indicative contribution to overall building score	2.00%
Total indicative BREEAM innovation credits achieved	0
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Level 3 = 40% improvement on notional baseline for water usage

Wat02 Water Monitoring

No. of BREEAM credits available	1	Available contribution to overall score	0.67%
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will there be a water meter on the mains water supply to the building(s)?	Yes	1	1
Will metering/monitoring equipment be specified on the water supply to any relevant plant/building areas?	Yes		
Will all specified water meters have a pulsed output?	Yes		
If the site/building has an existing BMS connection, will all pulsed meters be connected to the BMS?	Yes		

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	0.67%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Wat03 Water Leak Detection and Prevention

No. of BREEAM credits available	2	Available contribution to overall score	1.33%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will a mains water leak detection system be installed on the building's mains water supply?	Yes	1	1
Will flow control devices be installed in each sanitary area/facility?	Yes	1	1

Total indicative BREEAM credits achieved	2
Total indicative contribution to overall building score	1.33%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Wat04 Water Efficient Equipment

No. of BREEAM credits available	1	Available contribution to overall score	0.67%
No. of BREEAM innovation credits available	No	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will water efficient irrigation methods and/or vehicle wash systems (if relevant) be installed?	Yes	1	1

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Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	0.67%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

MATERIALS — Section Weighting 12.50% — Indicative Section Score 8.65%

Mat01 Life Cycle Impacts

No. of BREEAM credits available	6	Available contribution to overall score	5.77%
No. of BREEAM innovation credits available	1	Minimum standards applicable	No

Pre-Assessment question/criteria

How do you wish to assess the number of BREEAM credits achieved for this issue?	Define a target number of BREEAM credits to be achieved		
Select the number of BREEAM credits being targeted for the Mat01 issue	5	BREEAM Innovation credits	

Total indicative BREEAM credits achieved	5
Total indicative contribution to overall building score	4.81%
Total indicative BREEAM innovation credits achieved	0
Indicative minimum standard(s) level	N/A

Comments/notes:

Mat02 Hard Landscaping and Boundary Protection

No. of BREEAM credits available	1	Available contribution to overall score	0.96%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will ≥80% of all external hard landscaping and boundary protection achieve a Green Guide A or A+ rating?	Yes	1	1

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	0.96%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Mat03 Responsible Sourcing

No. of BREEAM credits available	3	Available contribution to overall score	2.88%
No. of BREEAM innovation credits available	1	Minimum standards applicable	Yes

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Pre-Assessment question/criteria

How do you wish to assess the number of BREEAM credits achieved for this issue?	Define a target number of BREEAM credits		
Select the number of BREEAM credits being targeted for the Mat03 issue	0	BREEAM Innovation credits	0
Will all timber used on the project be sourced in accordance with the UK Govt's Timber Procurement Policy?	Yes		

Total indicative BREEAM credits achieved	0
Total indicative contribution to overall building score	0.00%
Total indicative BREEAM innovation credits achieved	0
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Mat04 Insulation

No. of BREEAM credits available	2	Available contribution to overall score	1.92%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Is the building targeting an insulating index of 2 or more?	Yes	1	1
Will the building's insulating materials be responsibly sourced?	Yes	1	1

Total indicative BREEAM credits achieved	2
Total indicative contribution to overall building score	1.92%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Mat05 Designing for Robustness

No. of BREEAM credits available	1	Available contribution to overall score	0.96%
No. of BREEAM innovation credits available	0	Minimum standards applicable	N/A

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will suitable durability/protection measures be specified and installed to vulnerable areas of the building?	Yes	1	1

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	0.96%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

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BREEAM 2011 New Construction Pre-Assessment Estimator

WASTE	Section Weighting	7.50%	Indicative Section Score	7.50%

Wst01 Construction Waste Management

No. of BREEAM credits available	4	Available contribution to overall score	5.00%
No. of BREEAM innovation credits available	1	Minimum standards applicable	Yes

Pre-Assessment question/criteria

How do you wish to assess the number of BREEAM credits achieved for this issue?	Define a target number of BREEAM credits to be achieved		
Select the number of BREEAM credits being targeted for the Wst01 issue	4	BREEAM Innovation credits	0

Total indicative BREEAM credits achieved	4
Total indicative contribution to overall building score	5.00%
Total indicative BREEAM innovation credits achieved	0
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Wst02 Recycled Aggregates

No. of BREEAM credits available	1	Available contribution to overall score	1.25%
No. of BREEAM innovation credits available	1	Minimum standards applicable	No

Pre-Assessment question/criteria

How do you wish to assess the number of BREEAM credits achieved for this issue?	Define a target number of BREEAM credits to be achieved		
Select the number of BREEAM credits being targeted for the Wst02 issue	1	BREEAM Innovation credits	0

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	1.25%
Total indicative BREEAM innovation credits achieved	0
Indicative minimum standard(s) level	N/A

Comments/notes:

Wst03 Operational Waste

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No. of BREEAM credits available	1	Available contribution to overall score	1.25%
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will appropriate facilities for the storage of operational recyclable waste volumes be provided?	Yes	1	1
If relevant, will a static waste compactor(s) or baler(s) be specified/installed?	N/A		
If relevant, will a vessel for composting suitable organic waste be specified/installed?	N/A		

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	1.25%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

Wst04 Speculative Floor and Ceiling Finishes

Assessment Issue Not Applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved

Total indicative BREEAM credits achieved	N/A
Total indicative contribution to overall building score	N/A
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

LAND USE & ECOLOGY — Section Weighting 10.00% — Indicative Section Score 8.00%

LE01 Site Selection

No. of BREEAM credits available	2	Available contribution to overall score	2.00%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will at least 75% of the proposed development's footprint be located on previously been developed land?	Yes	1	1
Is the site deemed to be significantly contaminated?	No	1	0

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	1.00%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

LE02 Ecological Value of Site and Protection of Ecological Features

No. of BREEAM credits available	1	Available contribution to overall score	1.00%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

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Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Can the land within the construction zone be defined as 'land of low ecological value'?	Yes	1	1
Will all features of ecological value surrounding the construction zone/site boundary be protected?	Yes		

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	1.00%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

LE03 Mitigating Ecological Impact

No. of BREEAM credits available	2	Available contribution to overall score	2.00%
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Pre-Assessment question/criteria	
What is the likely change in ecological value (plant species richness) as a result of the sites development?	No negative change or improvement in plant species richness

Total indicative BREEAM credits achieved	2
Total indicative contribution to overall building score	2.00%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	Pre-Assessment result indicates the minimum standards for Outstanding level

Comments/notes:

LE04 Enhancing Site Ecology

No. of BREEAM credits available	3	Available contribution to overall score	3.00%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will a suitably qualified ecologist be appointed to report on enhancing and protecting site ecology?	Yes	3	3
Will the suitably qualified ecologists general recommendations be implemented?	Yes		
What is the targeted/intended improvement in ecological value as a result of enhancement actions?	Large improvement in plant species richness		

Total indicative BREEAM credits achieved	3
Total indicative contribution to overall building score	3.00%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

LE05 Long Term Impact on Biodiversity

No. of BREEAM credits available	2	Available contribution to overall score	2.00%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will the building meet BREEAM's mandatory criteria for this BREEAM issue?	Yes	2	1
Will a Biodiversity Champion be appointed to monitor/minimise impacts of site activities on biodiversity?	Yes		
Will the contractor provide training for the site workforce on how to protect ecology during the project?	Yes		

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Will the contractor record actions to protect biodiversity and monitor their effectiveness during construction?	No
Will a new ecologically valuable habitat, appropriate to the local area, be created?	No
Where flora/fauna habitats exist on site, will the contractor programme site works to minimise disturbance?	No
Will a partnership be set up by the design team with a local group that has wildlife expertise?	No

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	1.00%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

POLLUTION — Section Weighting 10.00% — Indicative Section Score 8.46%

Pol01 Impact of Refrigerants

No. of BREEAM credits available	3	Available contribution to overall score	2.31%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will refrigerant containing systems be installed in the assessed building?	No	3	3

Total indicative BREEAM credits achieved	3
Total indicative contribution to overall building score	2.31%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Pol02 NO_x Emissions

No. of BREEAM credits available	3	Available contribution to overall score	2.31%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	
Please enter the target/maximum NO_x emission level for space heating system	40.00	mg/kWh
Please enter the target/maximum NO_x emission level for the water heating system	100	mg/kWh

Total indicative BREEAM credits achieved	3
Total indicative contribution to overall building score	2.31%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

For 2 credits = space heating is max of 40 and water heating is max of 100.

Pol03 Surface Water Run off

No. of BREEAM credits available	5	Available contribution to overall score	3.85%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved

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What is the actual/likely annual probability of flooding for the assessed site?	Low	2	2
Will a compliant Flood Risk Assessment be undertaken?	Yes		
Will the site meet the BREEAM criteria for peak rate surface water run off?	Yes	1	1
Will the site meet the criteria for surface water run off volume, attenuation and/or limiting discharge?	No	1	0
Will the site be designed to minimise watercourse pollution in accordance with the BREEAM criteria?	No	1	0

Total indicative BREEAM credits achieved	3
Total indicative contribution to overall building score	2.31%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Pol04 Reduction of Night Time Light Pollution

No. of BREEAM credits available	1	Available contribution to overall score	0.77%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will the external lighting be designed to reduce light pollution?	Yes	1	1

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	0.77%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

Pol05 Noise Attenuation

No. of BREEAM credits available	1	Available contribution to overall score	0.77%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Pre-Assessment question/criteria	Response	Credits available	Indicative credits achieved
Will there be, or is there noise-sensitive areas/buildings within 800m radius of the development?	Yes	1	1
Will a noise impact assessment be completed and, if applicable, noise attenuation measures specified?	Yes		

Total indicative BREEAM credits achieved	1
Total indicative contribution to overall building score	0.77%
Total indicative BREEAM innovation credits achieved	N/A
Indicative minimum standard(s) level	N/A

Comments/notes:

INNOVATION — Section Weighting 10.00% — Indicative Section Score 2.00%

Inn01 Innovation

No. of BREEAM innovation credits available	10	Available contribution to overall score	10.00%
		Minimum standards applicable	No

Pre-Assessment question/criteria	Exemplary level achieved	Credits available	Indicative credits achieved
Man01 Sustainable Procurement	Yes	1	1
Man02 Responsible Construction Practices	Yes	1	1
Hea01 Visual Comfort	No	1	0

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Ene01 Reduction of CO2 Emissions	No	5	0
Ene04 Low and Zero Carbon Technology	No	1	0
Ene05 Energy Efficient Cold Storage	N/A	N/A	N/A
Wat01 Water Consumption	No	1	0
Mat01 Life Cycle Impacts	No	1	0
Mat03 Responsible Sourcing of Materials	No	1	0
Wst01 Construction Waste Management	No	1	0
Wst02 Recycled Aggregates	No	1	0

Total indicative BREEAM credits achieved	2
Total indicative contribution to overall building score	2.00%
Indicative minimum standard(s) level	N/A

Comments/notes:

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