150 HOLBORN SUSTAINABILITY STATEMENT

DAH REAL ESTATES SARL

APRIL 2016

DARPLUS

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150 Holborn - Planning Submission: Sustainability Statement

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Contents

Executive Summary

Dar Al-Handasah (DAH) has prepared this Sustainability Statement on behalf of the Client (DAH Real Estate sarl) in support of a planning application for the redevelopment of 150 Holborn, which will provide a mix of office accommodation (Class B1), retail floorspace (Class A1-A3), residential units (Class C3) and public realm improvements

Under Camden Council Planning guidance, the Project had a requirement to achieve a certain level of certification, which the design is currently abiding by until advised differently:

- BREEAM rating of 'Very Good' (for non-residential elements (office/retail)); and
- Code for Sustainable Home (CSH) rating of 'Level 4' (for new-built residential element).

Despite the withdrawal of the Code for Sustainable Homes (CSH) from regulation, the Project will be targeting an energy performance equivalent to CSH Level 4; a good achievement considering the site constraints and urban locale. Based on a pre-assessment, the commercial portion is on track to exceed the requirements and achieve a BREEAM 'Excellent' rating with a score of 86.8%.

Sustainable specific studies that have been undertaken as part of the planning submittal include a: Flood Risk Assessment (FRA), Ecology Survey (including Bat Survey), Air Quality Assessment and a Lifecycle Embodied Carbon Analysis.

With regards sustainable design principles, the Project is complying with the London Plan and Camden Development Policies (such as DP22 and DP 23); incorporating measures such as:

- Water-efficiency through low-flow fixtures as well as harvesting greywater to flush toilets and thus reduce stress on the local potable water and stormwater drainage systems;
- Enhancing positive ecological impact of development by including roof gardens and vertical vegetation within the design to encourage wildlife;
- Using sustainable urban drainage measures such as green roofs to reduce the volume and rate of run-off;
- Encouraging the use of alternative options to motor vehicles (public transit, bicycles, etc);
- Providing adequate storage space for operational waste; and
- Developing an energy efficient strategy for the Project.

1 Introduction

1.1 Introduction

This Sustainability Statement has been prepared by Dar Al-Handasah (DAH) in support of a planning application for the redevelopment of 150 Holborn which is bound by Holborn to the south, Gray's Inn Road to the west and Brooke Street to the east (see Figure 1).

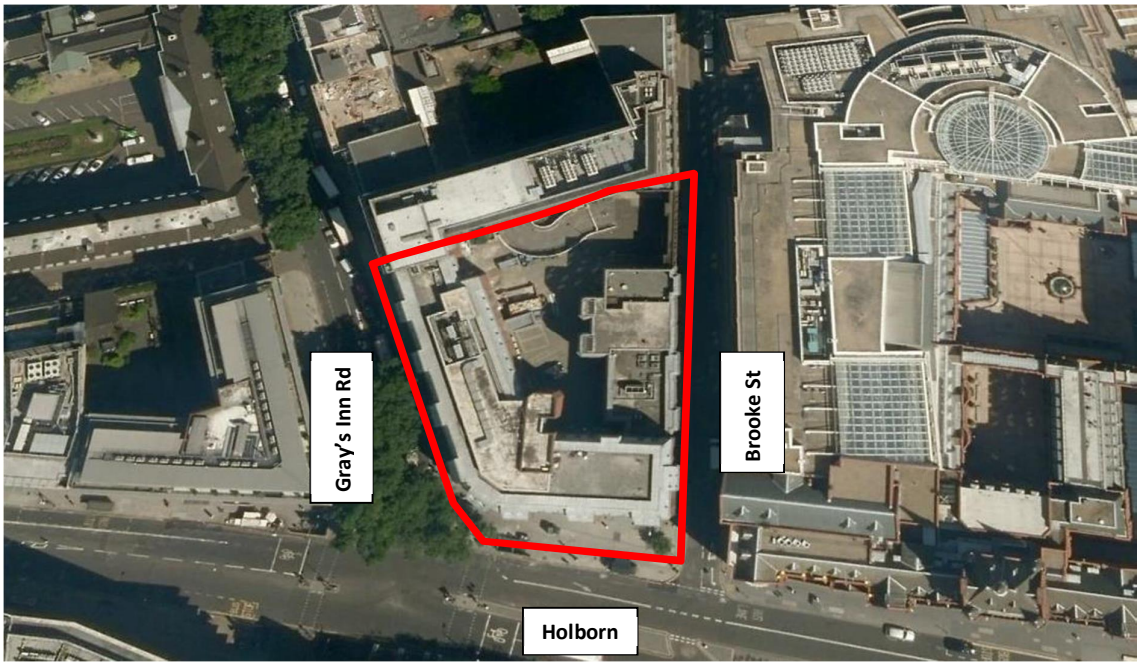

Figure 1 – Project Location

1.2 Project Overview

The redevelopment will provide mix of office accommodation (Class B1), retail floorspace (Class A1-A3), residential units (Class C3) and public realm improvements. The description of development is:

"Demolition of existing building and redevelopment for a mixed use development up to 9 storeys in height comprising 14,604 m^2 GEA office floorspace (Use Class B1), 1,450 m^2 GEA retail floorspace (Use Class A1-A3), 13 residential units (Use Class C3), improvements to the public realm and all other necessary enabling works."

1.3 Planning Submittal Requirements

This document (Sustainability Statement) has been developed in order to comply with Camden's Local Area Requirements for Planning Applications, which requires a sustainability statement that:

- Provide details of sustainable design and construction measures showing how you propose to reduce the energy, water and materials used in design and construction.
- The assessment that should be provided for Mixed Use (≥500 m^2 of Floorspace) is:
    - Code for sustainable Homes (for residential component)
    - BREEAM (assessment for the non-residential part)
- Energy – new and existing development
    - In line with CS13 and Chapter 2 Camden Planning Guidance 3 – Sustainability developments involving 5 or more dwellings and/or 500 m^2 (gross internal) or more are required to submit an energy statement which demonstrates how carbon dioxide emissions will be reduced in line with the energy hierarchy
- Flooding
    - Developments located up stream of or near to the areas shown on Core Strategy Map 5 (and Development Policies Map 2) must demonstrate how the development will not increase the risk of flooding through the inclusion of mitigation measures
    - Developments on sites of 1 hectare and over are to submit a Flood Risk Assessment in accordance with the NPPF and related guidance.
- Waste Reduction
    - All developments are to submit a statement stating how it will aim for at least 10% of the total value of materials used to be derived from recycled and reused sources. This should relate to the WRAP Quick Wins assessments or equivalent.
    - Major developments are anticipated to be able to achieve 15-20% of the total value of materials used to be derived from recycled and reused sources.

2 Planning Requirements

2.1 Overview

All developments in the London Borough of Camden should be compliant with the energy and sustainability requirements of the London Plan, as well as Camden's Core Strategy and Development policies. Further guidance is provided within Camden Planning Guidance (CPG) 3 on meeting these policies, including an energy statement and the detailing of how the development will implement the sustainable design principles as noted in Camden Development Policies DP22 and DP23.

BREEAM sustainability certification for the project is required in line with the Camden Planning Policies. Camden Borough planning approval for the previous (MAKE scheme) version of the Project necessitated that (in line with Camden Planning Guidance CPG 3 'Sustainability' and the Development Policies DP22 and DP23) it achieves:

- BREEAM rating of 'Very Good' (for non-residential elements (office/retail)); and
- Code for Sustainable Home (CSH) rating of 'Level 4' (for new-built residential element).

Additionally, the Project needs to achieve at least:

- 60% of the available credits in the BREEAM Energy category;
- 60% of the available credits in the BREEAM Water category; and
- 40% of the available credits in the BREEAM Materials category.

The Consultants have discussed the sustainability strategy and requirements with Camden Borough Council, and the criteria listed above are being followed (with BREEAM 'Excellent' being targeted).

2.2 London Borough of Camden

2.2.1 London Borough of Camden - Energy Statement

As part of the planning process, an Energy Statement should be submitted showing how the development will meet the following policy requirements:

- Follow the hierarchy of energy efficiency, decentralised energy and renewable energy technologies set out in the London Plan (2011) Chapter 5 to secure a 35% reduction in regulated CO_2 emissions below the maximum threshold allowed under Part L (2013).

- Where the London Plan carbon reduction target of 35% cannot be met on-site, Camden may accept the provision of measures elsewhere in the borough or a financial contribution (charged at £90/tonne CO_2/ year over a 30 year period), which will be used to secure the delivery of carbon reduction measures elsewhere in the Camden borough.
- Camden Core Strategy CS13 requires all developments to achieve a 20% reduction in CO_2 emissions through renewable technologies (the 3rd stage of the energy hierarchy) wherever feasible, and this should be demonstrated through the energy statement. Any shortfall in the 20% renewable energy target should be justified through a feasibility analysis.
- There is an aspiration for all inaccessible roof areas to accommodate photovoltaic panels (PV). If the 35% improvement on Part L regulations is achieved then a lower provision of PVs (in order to create more green roof areas) is likely to be an acceptable position.

2.2.2 London Borough of Camden - DP22: Promoting Sustainable Design and Construction

The Council will require development to incorporate sustainable design and construction principles as noted in policy DP22 including (but not limited to) measures outlined below:

- Demonstrate how sustainable development principles, including the relevant measures set out below, have been incorporated into the design and proposed implementation; and

Design	Fabric/Services
• the layout of uses • floorplates size/depth • floor to ceiling heights • location, size and depth of windows • limiting excessive solar gain • reducing the need for artificial lighting • shading methods, both on or around the building • optimising natural ventilation • design for and inclusion of renewable energy technology • impact on existing renewable and low carbon technologies in the area • sustainable urban drainage, including provision of a green or brown roof • adequate storage space for recyclable material, composting where possible • bicycle storage • measures to adapt to climate change (see below) • impact on microclimate	• level of insulation • choice of materials, including - responsible sourcing, re-use and recycled content • air tightness • efficient heating, cooling and lighting systems • effective building management system • the source of energy used • metering • counteracting the heat expelled from plant equipment • enhancement of/provision for biodiversity • efficient water use • re-use of water • educational elements, for example visible meters • on-going management and review

- Incorporate green or brown roofs and green walls wherever suitable.

The Council will promote and measure sustainable design and construction by:

- Expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016.;
- Expecting developments (except new build) of 500 m^2 of residential floorspace or above or 5 or more dwellings to achieve “very good” in EcoHomes assessments prior to 2013 and encouraging “excellent” from 2013;
- Expecting non-domestic developments of 500sqm of floorspace or above to achieve “Very Good” in BREEAM assessments (“Excellent” from 2016); encouraging zero carbon from 2019.

The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

- Summer shading and planting;
- Limiting run-off;
- Reducing water consumption;
- Reducing air pollution; and
- Not locating vulnerable uses in basements in flood-prone areas.

2.2.3 London Borough of Camden - DP23: Water

The Council will require developments to reduce their water consumption, the pressure on the combined sewer network and the risk of flooding by:

- Incorporating water efficient features and equipment and capturing, retaining and re-using surface water and grey water on-site;
- Limiting the amount and rate of run-off and waste water entering the combined storm water and sewer network through the methods outlined above and other sustainable urban drainage methods to reduce the risk of flooding;
- Reducing the pressure placed on the combined storm water and sewer network from foul water and surface water run-off and ensuring developments in the areas identified by the North London Strategic Flood Risk Assessment and shown on Map 2 as being at risk of surface water flooding are designed to cope with the potential flooding;
- Ensuring that developments are assessed for upstream and downstream groundwater flood risks in areas where historic underground streams are known to have been present; and

- Encouraging the provision of attractive and efficient water features.

2.2.4 London Borough of Camden – Additional Requirements

Following on from the pre-planning meeting on 17th November 2015, the additional sustainability requirements were placed on the Project by Camden Borough planners:

- Although the cycling facilities will be designed in accordance with the spatial requirements from Camden Planning Policy Guidance CPG7, it is necessary to achieve the more stringent cycling standards within the latest London Plan (FALP) rather than those required within CPG7, BREAAM or LEED schemes.
- Justification for the demolition of the existing building is required (Lifecycle Carbon Analysis), specifically an analysis of net reduction in carbon operational and embodied carbon levels.
- There will be a requirement to provide an :
    - Air Quality Assessment;
    - Ecology (Bat) Survey; and
    - Flood Risk Assessment.
- The scheme would need to consider an appropriate SUDs strategy in accordance with NPPF guidance. Specifically, a 50% improvement on run off rates is required, in line with Camden Planning Guidance 3, Section 11.5.

2.3 London Plan

The London Plan includes a range of policies related to climate change, with the majority of the mitigation and adaptation policies referenced within the Energy Strategy section of this report.

Policy 5.3: 'Sustainable Design and Construction' requires that the highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new developments and to adapt to the effects of climate change over their lifetime.

Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process. Major development proposals should meet the minimum standards

outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve other policies in this Plan and the following sustainable design principles:

- Minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems);
- Avoiding internal overheating and contributing to the urban heat island effect;
- Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings;
- Minimising pollution (including noise, air and urban runoff);
- Minimising the generation of waste and maximising reuse or recycling;
- Avoiding impacts from natural hazards (including flooding);
- Ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions;
- Securing sustainable procurement of materials, using local supplies where feasible; and
- Promoting and protecting biodiversity and green infrastructure.

Within Local Development Frameworks, boroughs (such as Camden) have considered developing more detailed policies and proposals based on the sustainable design principles outlined above and those which are outlined in the Mayor's supplementary planning guidance that are specific to their local circumstances.

2.4 Design Response

All aspects of the of the design, fabric and services for the dwellings and commercial building have been assessed and reviewed to ensure that the environmental benefits of the development are in keeping with the location and setting of the site.

Sustainable design standards are integral to the Project and have been considered at the beginning of the design process; with sustainability discussed at kick-of, incorporated in the Project Brief and sustainability charrettes/workshops held.

The following sections of the Sustainability Statement describe the sustainable design aspects that have been considered to conform to Client and Planning requirements:

- Section 3 - BREEAM Pre-Assessment

- Section 4 – Energy
- Section 5 – Flooding
- Section 6 – Waste Reduction and Materials
- Section 7 – Water
- Section 8 – Biodiversity
- Section 9 – Transport
- Section 10 - Pollution

3 BREEAM and CSH Pre-Assessment

3.1 Overview

The development is a Mixed Use (≥500sqm of Floorspace) project, and as per Camden's Local Area Requirements for Planning Applications February 2014, the following sustainability assessment tools need to be undertaken:

- Code for Sustainable Homes (for residential component)
- BREEAM (assessment for the non-residential part)

3.2 BREEAM Pre-Assessment - Non-Residential

3.2.1 Camden Planning Requirements

As mentioned in Section 2.1, BREEAM sustainability certification for the project is required in line with the Camden Planning Policies (including Camden Planning Guidance (CPG) 3 'Sustainability' and the Development Policy DP22 'Promoting sustainable design and construction'), with London Borough of Camden requesting that the Project achieves:

- BREEAM rating of 'Very Good' (for non-residential elements (office/retail)); and
- Code for Sustainable Home (CSH) rating of 'Level 4' (for new-built residential element).

Additionally, the Project needs to achieve at least:

- 60% of the available credits in the BREEAM Energy category;
- 60% of the available credits in the BREEAM Water category; and
- 40% of the available credits in the BREEAM Materials category.

3.2.2 Design Overview

The Project is targeting BREEAM 'Excellent' through the BREEAM UK New Construction 2014 scheme

A BREEAM Pre-Assessment report for the Project has been completed and is attached with this statement. It includes assumptions on design development and construction initiatives, and has a target credit score of 86.8%.

This target exceeds the 70% threshold for a BREEAM 'Excellent' rating and includes a buffer against the potential loss of credits during design. It is expected that the final score at post-construction would exceed the threshold for Excellent, but would probably be below the Pre-Assessment score.

3.2.3 Methodology

The BREEAM calculation methodology for the NC 2014 scheme includes a mandatory performance requirement for energy consumption, demand and carbon reduction for an 'Excellent' rating. Preliminary modelling demonstrates that the required improvement in energy performance is achievable with the proposed mechanical systems, envelope performance and contribution from renewable technologies.

3.2.4 Pre-Assessment Scorecard

The target scenario for BREEAM Excellent is summarised in the table below. The current predicted rating is based on a combination of evidence in the current design and commitments by the Applicant to include specific elements in the scheme in the next stages of design.

Credit	Description	Points		Responsibility
		Available	Targeted	
Management		**21**	**21**	**12.0%**
Man 01	Project brief and design	4	4	Architect / BREEAM Assessor / Client / Project Manager
Man 02	Life cycle cost & service life planning	4	4	Cost Consultant
Man 03	Responsible construction practices	6	6	Contractor
Man 04	Commissioning and handover	4	4	MEP Engineer / Contractor
Man 05	Aftercare	3	3	MEP Engineer / Client
Health and Well-Being		**17**	**14**	**12.4%**
Hea 01	Visual comfort	4	3	MEP Engineer / Architect
Hea 02	Indoor air quality	5	4	MEP Engineer
Hea 04	Thermal comfort	3	3	MEP Engineer
Hea 05	Acoustic performance	3	2	Acoustic Consultant / Architect
Hea 06	Safety and security	2	2	Architect / Transport Consultant
Energy		**23**	**18**	**11.7%**
Ene 01	Reduction of energy use and carbon emissions	12	8	MEP Engineer
Ene 02	Energy monitoring	2	2	MEP Engineer
Ene 03	External lighting	1	1	MEP Engineer
Ene 04	Low carbon design	3	2	MEP Engineer

Credit	Description	Points		Responsibility
		Available	Targeted	
Ene 06	Energy efficient transport systems	3	3	MEP Engineer / Lift Consultant
Ene 08	Energy efficient equipment	2	2	MEP Engineer / Architect
Transport		**9**	**9**	**9.0%**
Tra 01	Public transport accessibility	3	3	BREEAM Assessor
Tra 02	Proximity to amenities	1	1	Architect
Tra 03	Cyclist facilities	2	2	Architect / Transport Consultant
Tra 04	Maximum car parking capacity	2	2	Architect / Transport Consultant
Tra 05	Travel plan	1	1	Transport Consultant
Water		**8**	**6**	**5.3%**
Wat 01	Water consumption	5	3	Architect / MEP Engineer
Wat 02	Water monitoring	1	1	MEP Engineer
Wat 03	Water leak detection	2	2	MEP Engineer
Materials		**13**	**10**	**10.4%**
Mat 01	Life cycle impacts	5	3	Architect / Structural Engineer
Mat 02	Hard landscaping & boundary protection	1	1	Architect
Mat 03	Responsible sourcing of materials	4	3	Architect / Procurement
Mat 04	Insulation	1	1	Architect / MEP Engineer
Mat 05	Designing for durability & resilience	1	1	Architect / Structural Engineer
Mat 06	Material efficiency	1	1	Structural Engineer
Waste		**9**	**7**	**6.6%**
Wst 01	Construction waste management	4	3	Contractor / Architect
Wst 02	Recycled aggregates	1	0	Structural Engineer
Wst 03	Operational waste	1	1	Architect / Transport Consultant
Wst 04	Speculative floor and ceiling finishes	1	1	Client
Wst 05	Adaptation to climate change	1	1	Structural Engineer
Wst 06	Functional adaptability	1	1	Architect
Land Use and Ecology		**10**	**9**	**9.0%**
LE 01	Site selection	2	1	Architect
LE 02	Ecological value of site & protection of ecological features	2	2	Ecologist
LE 03	Minimising impact on existing site ecology	2	2	Ecologist / Contractor
LE 04	Enhancing site ecology	2	2	Ecologist / Landscape Architect
LE 05	Long term impact on biodiversity	2	2	Ecologist
Pollution		**13**	**11**	**8.5%**
Pol 01	Impact of refrigerants	3	3	MEP Engineer
Pol 02	NOx emissions	3	1	MEP Engineer
Pol 03	Surface water run-off	5	5	Structural Engineer
Pol 04	Reduce night time light pollution	1	1	MEP Engineer
Pol 05	Reduction of noise pollution	1	1	Acoustic Consultant
Innovation		**10**	**2**	**2.0%**
Inn 1.3	Man 05: Aftercare	1	1	MEP Engineer
Inn 1.12	Wst 05: Adaption to climate change	1	1	Architect
TOTAL BREEAM SCORE		**Excellent**		**86.8%**

3.2.5 Camden Policy Guidance 3: Sustainability Targets

The project meets the BREEAM section sub-targets included in CPG3: Sustainability as follows:

Category	Target	Score
Energy	60%	78.3%
Water	60%	77.8%
Materials	40%	76.9%

3.2.6 Next Steps

In order to achieve the target BREEAM rating upon completion of construction, the design team would continue to liaise with the BREEEAM Assessor for the project, to monitor and document progress against each credit. The following approach would be taken to achieve the target rating:

- The BREEAM Assessor would attend regular meetings with the design team to maintain familiarity with the BREEAM process and compliance criteria.
- A Design Stage Assessment would be carried out and submitted to the BRE upon completion of tender documentation, to validate the proposed design strategies.
- The Contractor appointed for the scheme would be responsible for achieving the targeted BREEAM rating on the development. The pre-assessment carried out at design stage demonstrates that a score exceeding the ‘Excellent’ threshold is achievable, however the BREEAM system is designed to be flexible and therefore the developer may achieve the ‘Excellent’ threshold using a different solution. A final BREEAM assessment would be undertaken at completion of construction to verify the project’s rating.

3.3 CSH Pre-Assessment - Residential Portion

3.3.1 Overview

The Ministerial Statement of 25th March 2015 has resulted in the Housing Standards Review withdrawing the Code for Sustainable Homes (except for legacy cases) and set a new system of optional Building Regulations on water and access as well as a new national space standard.

The draft MALP 2015 London Plan policy 5.3 'Sustainable design and construction' removes requirements for the Code for Sustainable Homes (CSH) but continues to require development to demonstrate that sustainable design standards are integral to the proposal, including its construction and operation.

3.3.2 Camden Planning Requirements

Acceptable new residential schemes will be required by Camden Council to ensure that the measures stated in the Sustainability Statement are secured and implemented, including:

- New residential development will be required to demonstrate that the development is capable of achieving a maximum internal water use of 105 litres per person/day, with an additional 5 litres person/day for external water use (Wat 01: Indoor Water Consumption).
- Follow the hierarchy of energy efficiency, decentralised energy and renewable energy technologies set out in the London Plan (2011) Chapter 5 (particularly Policy 5.2) to secure a minimum 20% reduction in regulated carbon dioxide emissions below maximum threshold allowed under Part L 2013 (20% is equivalent to CSH Level 4 mandatory requirements).
- Policy CS13 also requires that all developments (existing and new build) achieve a 20% reduction in on-site carbon dioxide emissions through renewable technologies, unless demonstrated that such provision is not feasible.

3.3.3 CSH Pre-Assessment

The target scenario for CSH summarised in the table below. The current predicted rating of 69% (Level 4) is based on a combination of evidence in the current design and commitments by the Applicant to include specific elements in the scheme in the next stages of design.

Credit	Description	Points		Responsibility
		Available	Targeted	
Energy & CO2 Emissions		**31**	**17**	**19.9 %**
Ene 01	Dwelling emission rate	10	3	MEP Engineer
Ene 02	Fabric energy efficiency	9	5	MEP Engineer / Architect

Credit	Description	Points		Responsibility
		Available	Targeted	
Ene 03	Energy display devices	2	2	MEP Engineer / Architect
Ene 04	Drying space	1	1	Architect
Ene 05	Energy labelled white goods	2	2	MEP Engineer / Client
Ene 06	External lighting	2	2	MEP Engineer / Architect
Ene 07	Low and zero carbon technologies	2	0	MEP Engineer / Architect
Ene 08	Cycle storage	2	2	Architect
Ene 09	Home office	1	0	Architect
Water		**6**	**4**	**6 %**
Wat 01	Indoor water use	5	3	MEP Engineer / Architect
Wat 02	External water use	1	1	MEP Engineer / Architect
Materials		**24**	**16**	**4.8 %**
Mat 01	Environmental impact of materials	15	10	Architect
Mat 02	Responsible sourcing of materials – basic building elements	6	4	Architect
Mat 03	Responsible sourcing of materials – finishing elements	3	2	Architect
Surface Water Run-Off		**4**	**4**	**2.2 %**
Sur 01	Management of surface water run-off from developments	2	2	Architect / Structural Engineer
Sur 02	Flood risk	2	2	Architect / Structural Engineer
Waste		**8**	**6**	**4.8 %**
Was 01	Storage of non-recyclable waste and recyclable household waste	4	4	Architect
Was 02	Construction site waste management	3	2	Contractor / Architect
Was 03	Composting	1	0	Architect
Pollution		**4**	**2**	**1.4 %**
Pol 01	Global warming potential (GWP) of insulants	1	1	MEP Engineer
Pol 02	NOx emissions	3	1	MEP Engineer
Health & Well-Being		**12**	**10**	**11.7 %**
Hea 01	Daylighting	3	2	MEP Engineer / Architect
Hea 02	Sound insulation	4	3	Structural Engineer/ Architect
Hea 03	Private space	1	1	Architect
Hea 04	Lifetime Homes	4	4	Architect / Client
Management		**9**	**8**	**8.9 %**
Man 01	Site selection Home user guide	3	3	Architect
Man 02	Considerate Constructors Scheme	2	1	Contractor / Architect
Man 03	Construction site impacts	2	2	Contractor / Architect
Man 04	Security	2	2	Architect
Ecology		**9**	**7**	**9.3 %**
Eco 01	Ecological value of site	1	1	Ecologist
Eco 02	Ecological enhancement	1	1	Ecologist / Landscape Architect
Eco 03	Protection of ecological features	1	1	Ecologist / Contractor
Eco 04	Change in ecological value of site	4	3	Ecologist / Landscape Architect
Eco 05	Building footprint	2	1	Architect
TOTAL CSH SCORE		**CSH Level 4**		**69 %**

The residential portion of the development has been designed with these requirements in mind and the Project is on track for a score in excess of 68% (the CSH 'Level 4' threshold), as well as to achieve the CSH Level 4 minimum standard requirements for internal water use (Wat 01: Indoor Water Consumption) and energy efficiency (Ene01: Dwelling Emission Rate).

This 25% Improvement in Dwelling Emission Rate over Target Emission Rate (equivalent to 20% reduction in regulated carbon dioxide emissions below maximum threshold allowed under Part L 2013) is demonstrated within the Energy Strategy (Section 4).

4 Energy

4.1 Overview

Details on the energy strategy for the development are provided within the 'Energy Strategy' Report

4.2 Planning Requirements

As part of the planning process, Camden Borough requires that an Energy Statement should be submitted showing how the development will meet the following policy requirements:

- Follow the hierarchy of energy efficiency, decentralised energy and renewable energy technologies set out in the London Plan (2011) Chapter 5 to secure a 35% reduction in regulated CO_2 emissions below the maximum threshold allowed under Part L (2013).
- Where the London Plan carbon reduction target of 35% cannot be met on-site, Camden may accept the provision of measures elsewhere in the borough or a financial contribution (charged at £90/tonne CO_2/ year over a 30 year period), which will be used to secure the delivery of carbon reduction measures elsewhere in the Camden borough.
- Camden Core Strategy CS13 requires all developments to achieve a 20% reduction in CO_2 emissions through renewable technologies (the 3rd stage of the energy hierarchy) wherever feasible, and this should be demonstrated through the energy statement. Any shortfall in the 20% renewable energy target should be justified through a feasibility analysis.
- There is an aspiration for all inaccessible roof areas to accommodate photovoltaic panels (PV). If the 35% improvement on Part L regulations is achieved then a lower provision of PVs (in order to create more green roof areas) is likely to be an acceptable position.

4.3 Energy Strategy

The following Energy Hierarchy, as set out in the GLA guidance on preparing energy assessments methodology, was adopted to help guide decisions about which energy measures are appropriate, and in order to optimise design solutions to maximise carbon reductions:

- Be Lean: using less energy and utilising passive sustainable design measures;
- Be Clean: supplying energy efficiency, including the use of decentralised energy production;

- Be Green: using renewable energy where possible to further reduce carbon emissions.

Design measures to limit local pollution from heating sources are addressed within the Energy Strategy Report and include the reduction of:

- Carbon dioxide emissions across the site, including the building and services;
- Internal overheating and contributing to the urban heat island effect; and
- Efficient use of natural resources (e.g. gas, water and electricity usage)

The Energy Strategy Report shows that best in class mechanical and electrical system efficiencies together with a high performing building fabric significantly reduces carbon emissions (21.8%). There is not a viable year-round load to make CHP (combined heat and power) suitable; therefore this technology has not been included to reduce carbon emissions. Photovoltaic panels are the only suitable renewable technology for this development.

5 Waste Reduction

5.1 Overview

Measures to minimise waste generation whilst also endorsing the maximisation of recycling and re-use of materials is addressed within the 'Waste and Servicing Management Plan', in accordance with the requirements of Camden Planning Guidance.

5.2 Planning Requirements

Camden Sustainability Statement requires the following to be addressed:

- All developments are to submit a statement stating how it will aim for at least 10% of the total value of materials used to be derived from recycled and reused sources. This should relate to the WRAP Quick Wins assessments or equivalent.
- Major developments are anticipated to be able to achieve 15-20% of the total value of materials used to be derived from recycled and reused sources.

5.3 Materials Strategy

From the BREEAM Pre-Assessment, the project in on target to achieve 76.9% of the Materials credits – with 40% being the minimum target set by Camden Borough.

The London Plan and supporting policy documents highlight materials and their life cycle impacts as a key priority for achieving sustainable development in the built environment. A preliminary Materials Audit has been carried out using the BREEAM methodology for credit Mat 01 (Life Cycle Impacts), predicting that 3 of the 5 available materials credits would be achieved for the project.

A sustainable procurement plan is being developed for the project that will specify responsible sourcing of materials, which will include environmental product declarations (EPD) as well as targets for the recycled content of materials (by value) in line with Camden requirements. It is the intention of the development to use only materials that are certified under a Green Product Certification Scheme in order to minimize the embodied energy and associated environmental impact – this will be referenced within the project Sustainable Procurement Plan. This will ensure that materials used in the design are sustainably procured and will come from a supervised and responsibly sourced supply chain; using local supplies where feasible.

6 Flood Risk

6.1 Planning Requirements

6.1.1 Flood Risk Assessment

Camden Borough planning approval for this Project necessitates that certain documents are submitted by the end of Concept Design (RIBA Stage 2). As part of the sustainability statement, a section on Flooding must be included that covers the following requirements:

- Developments located up stream of the areas shown on Core Strategy Map 5 (and Development Policies Map 2) must demonstrate how the development will not increase the risk of flooding through the inclusion of mitigation measures
- Development on sites of 1ha and over are to submit a Flood Risk Assessment (FRA)

6.1.2 Stormwater Management

The additional Camden Planning requirements also exist with regards stormwater management:

- Within Camden, Sustainable Drainage Systems (SuDS) must be designed in accordance with London Plan Policy 5.13: 'Sustainable Drainage'. This requires that developments should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the drainage hierarchy
- Camden Planning Guidance 3 (CPG3) requires developments to achieve a greenfield run off rate once SuDS have been installed. Where it can be demonstrated that this is not feasible, a minimum 50% reduction in run off rate across the development is required.

6.2 Design Response – Flood Risk Analysis

6.2.1 Flood Risk Analysis

The noted map (Figure 2), was developed by Environment Agency to show parts of the borough that have experienced significant sewer or surface water flooding and places that are considered to have the potential to be at risk of surface water flooding, given the topography and depth of the site.

From the Property Flood Likelihood Database sourced from the Environment Agency's National Receptor Dataset (NRD), it is noted that the Project site (circled in red) is not within Flood Zones 2 or 3, and is thus in Flood Zone 1 with a low probability of flooding (Figure 3).

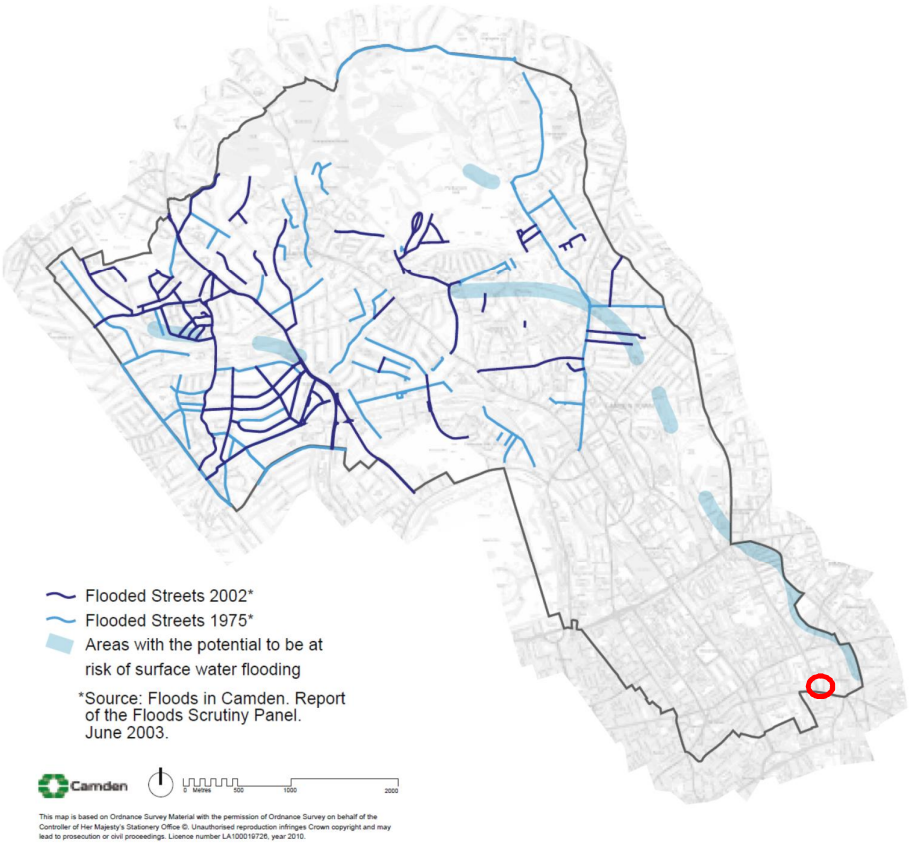

Figure 2 – Project Flood Risk (Project site (circled in red) is outside of the affected flood risk areas)

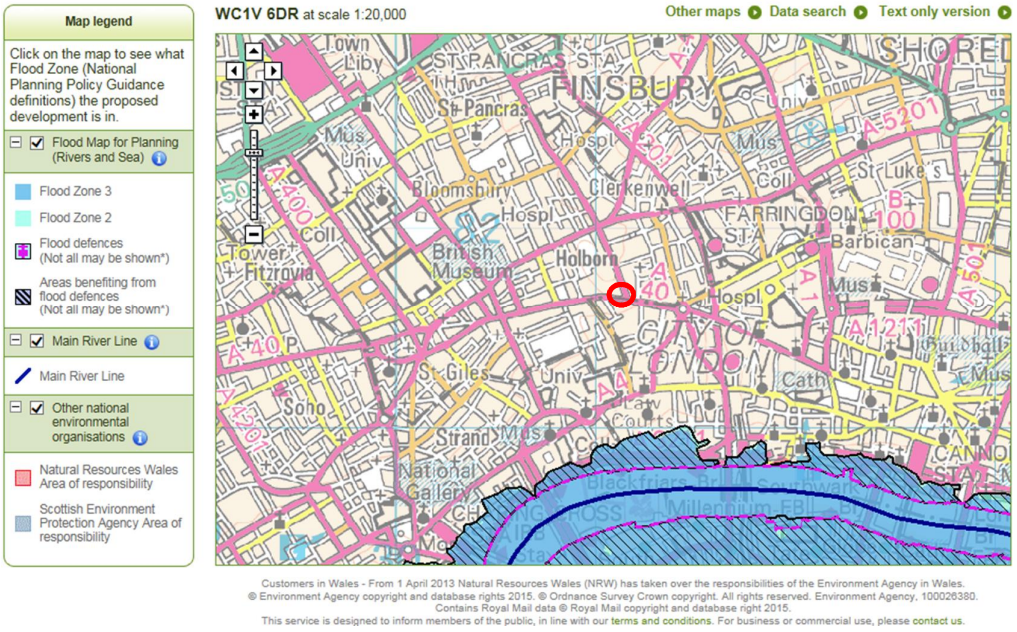

Figure 3 – EA Project Flood Zones

As the development is less than 1 hectare in size (0.29 ha) and within Flood Zone 1 (unless it could be affected by sources of flooding other than rivers and the sea, e.g. surface water drains), neither Camden nor the Environment Agency (EA) require a full FRA as part of the planning process.

The development has also been assessed with regards to the London Plan Policy 5.12: 'Flood Risk Management' and noted that the development is outside of any known flood-risk areas.

A Site Solutions report was produced by Argyll Environment in March 2015 as part of the Client's purchase of the site. It identified the Flood Risk as Low - the Site is not considered to be at a significant risk of flooding, and noted the following:

- The Site is at a low risk of flooding from rivers or the sea (as it is at a relatively high elevation above sea level) ;
- There are no water features shown on the Ordnance Survey maps within 500m of the Site;
- There is a negligible risk of groundwater flooding in this area and any groundwater flooding incidence will be less frequent than 1 in 200 years return period ;
- The EA's records have no indication of past flooding within 500m of the Site; and
- There are no rivers, canals, or drainage channels identified by the regulatory body's detailed river network within 500m of the Site

6.2.2 Flood Risk Assessment

Further discussions with Camden Borough planners on 17th November 2015 resulted in a request for a Flood Risk Assessment (FRA) to be produced as part of the planning submittal.

Therefore, in line with BREEAM Pol 03: Flood Risk, a FRA was undertaken by consultants (Sanderson Associates) to provide a more detailed understanding of the site. It has identified that the project is within a low flood-risk location. With this in mind, the Project basement area is being protected against water penetration so that it can be used for back of house purposes (siting of mechanical plant and cycle storage) along with retail basement uses.

The FRA is attached as part of the Planning Submittal.

6.3 Design Response – Stormwater Management

Camden Borough requires that the scheme would need to consider an appropriate Sustainable urban drainage systems (SuDS) strategy in accordance with NPPF guidance. Specifically, a 50% improvement on run off rates is required, in line with Camden Planning Guidance 3, Section 11.5.

Sustainable urban drainage systems for the development have been utilised in accordance with the requirements, to ensure that surface water run-off is managed as close to its source as possible, with measures such as green roofs and attenuation tanks analysed for feasibility.

With regards stormwater management, urban run-off has been calculated for the project, with:

- The volume and rate of run-off from heavy rainfall designed to be reduced through the use of appropriate sustainable urban drainage systems (SuDS), including vegetative roofs (sedum) which have the capacity to moderate this rainfall runoff through both retention (water holding) and detention (flow-slowing) properties; and
- Run-off calculations presented to Thames Water to ascertain whether additional rainwater attenuation tanks will be needed for the site.

7 Water

Water consumption will be reduced in line with Camden's DP23 requirements for efficient use of water, with the following design measures considered:

- Wastewater would be collected from sinks, showers and washing machines within the commercial and residential buildings. This water would discharge into greywater treatment plant, which would be located in the basement. Once treated, the water would be supplied back into the development for re-use (e.g. toilet flushing);
- Water efficient fixtures, fitting and appliances such as low-flush toilets are specified within the commercial and residential portions of the development;
- In line with Camden Policy Guidance 3 (CPG3) Sustainability Targets, the development is on target for achieving 60% BREEAM of the available water credits (currently targeting 77.8%);
- No water features have been incorporated within the current design.

8 Biodiversity

Biodiversity is promoted and protected within the development. To ensure that the site ecology is protected and enhanced, a Suitably Qualified Ecologist has undertaken an ecology survey (including bat survey and tree survey). Their recommendations will be incorporated into the final scheme, and they have proposed ecological enhancements such as:

- The roofs of the residential block are designed to be covered by green roofs (an extensive sedum roof system is proposed), with the Level 8 floor of the office building including a substantial roof garden that will incorporate a variety of natural and adaptive vegetation types that will suit the local environment and attract indigenous wildlife. These roof terraces will include a pavilion feature to provide shading for people visiting them, along with strategically located trees and other shade structures;
- Within the passageway and backyard shared surface, there is a vertical garden proposed as a ribbon of walled vegetation along the project boundary; and
- Although the tree survey and bat surveys did not indicate that there were either protected trees or nesting bats within the site, they advised design, construction or operational measures to implement to minimise and ecological impacts. Ecological features will be incorporated into the design, adding ecological value to the site by providing habitats and resources for a variety of species (principally, invertebrates, birds, bats).

The Ecology Report is provided within this Planning Submittal

9 Transport

The proximity to the Chancery Lane tube station as well as Farringdon train station and myriad bus routes will be advantageous and encourage use of public transport, thus necessitating minimal car-parking (2-3 spaces) within the development.

Road traffic is the main source of pollution in the area, with the provision of bicycle facilities expected to encourage staff to reduce their dependence on motor vehicles.

- Camden requested that design of bicycle facilities complied with London Plan Policy 6.9 (1 space per 90m^2 = 210 racks) rather than Camden requirements (67 racks) - both of which exceed LEED (50) & BREEAM (30) requirements; and
- Design has 1 (out of 2) parking spaces with an electrical charging point to encourage uptake of electric vehicles. This meets London Plan (Policy 6.13) that 1 in 5 spaces provide them.

10 Pollution

Pollution (including noise, air and urban run-off) has been minimised, with specialist consultants engaged to produce air quality assessments, noise and vibration studies and flood risk assessments, with recommendations to reduce negative impacts implemented.

The following surveys are submitted as part of the Planning Submittal:

- Air Quality Assessment; and
- Flood Risk Assessment.

11 Lifecycle Carbon Analysis

11.1 Overview

Camden Borough requested that justification for the demolition of the existing 150 Holborn building was required in the form of a Lifecycle Carbon Analysis (LCA); specifically, an analysis of net reduction in carbon operational and embodied carbon levels.

The planning aspiration behind the request is that demolition should occur only where there is a net carbon saving to be achieved.

11.2 Methodology

The operational energy information is within the Energy Strategy report, but the embodied carbon of the two different buildings is a notable study and requires:

- A lifecycle carbon comparison between:
  - The proposed building; and
  - A nominal building (refurbishing and extending the existing building to be a similar size as the proposed building)
- The analysis should include;
  - the operational carbon footprint of the existing building plus refurbishment and embodied impacts of upgrade and extension, versus
  - new building operational + embodied carbon of new construction and demolition

In the absence of clear guidance, the analysis is being done in line with the methodology in the BREEAM New Construction credit Mat01: Life Cycle Impacts.

11.3 Analysis

The proposed building's embodied carbon was found to be 20% lower than that of the existing building. It should be noted that the proposed building will have a gross external area around 33% higher than the existing.

An embodied carbon study forms part of a Life Cycle Analysis with Operational Carbon being the other part. The proposed building was designed with reduction in Operational Carbon in mind. It is

targeting several energy credits in both LEED and BREEAM and falls under rigorous regulations to ensure it operates with the highest standards. The building's performance and efficiency will be significantly higher than those of the existing.

Due to the design still being at early stage, it was necessary to make assumptions for construction materials, including:

- Due to the constant updates of the BRE Green Guide, the existing building is assumed to have been built at the same time as the proposed building will be;
- Due to building being in very early design stage when the study was made, a date was chosen in which the design was frozen (in terms of areas) and the embodied carbon study performed on (8th of January 2016); and
- Due to building being in very early design stage when the study was made, most construction materials are yet to have been confirmed. A meeting was held between the sustainability team, architects and project managers to agree on the most probable materials to be used. These materials were then approximated to the closest existing Green Guide construction materials and are assumed to be the correct ones.

The Embodied Carbon Analysis report is attached an as appendix to this document.

Appendix A: Life Cycle Analysis: Embodied Carbon

150 Holborn – Life Cycle Analysis: Embodied Carbon

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Contents

Executive Summary

Dar Al-Handasah (DAH) London Sustainability Group (referred to as the sustainability team hereafter) is providing guidance on the costs, steps and benefits associated with obtaining sustainability rating system certification for the redevelopment of 150 Holborn as the new Dar Group UK Headquarters; providing a mix of office accommodation (Class B1), retail floorspace (Class A1-A3), residential units (Class C3) and public realm improvements.

Camden Council has requested an embodied carbon study to be performed on the proposed and existing buildings. The main aim of this study is to help justify the demolition of the existing structure through comparing its embodied energy with that of the proposed building.

The methodology proposed for conducting the Life Cycle Analysis is based on The Building Research Establishment Environmental Assessment Methodology's (BREEAM) Life Cycle Impacts credit found in BREEAM New Construction 2014. This methodology makes use of the Green Guide to Specification in finding the embodied carbon of different materials.

As this project is aiming to achieve BREEAM and Leadership in Energy and Environmental Design (LEED) certification, a Life Cycle Analysis will be undertaken at a later stage in this report. The aim for this study can be therefore extended towards also aiding the future work that has to be done by sustainability team.

Due to the design still being at early stage, it was necessary to make assumptions for construction materials. All assumptions will be mentioned in this report and will have been reviewed by all relevant sides of the Project Design Team.

The proposed building's embodied carbon was found to be 20% lower than that of the existing building.

1 Introduction

1.1 Project Background

Dar Al-Handasah (DAH) London Sustainability Group (referred to as the sustainability team hereafter) is providing guidance on the costs, steps and benefits associated with obtaining sustainability rating system certification for the redevelopment of 150 Holborn (the Project) as the new Dar Group UK Headquarters; providing a mix of office accommodation (Class B1), retail floorspace (Class A1-A3), residential units (Class C3) and public realm improvements.

The following companies form the Project Design Team and will be referred to with their profession name hereafter:

1) Perkins + Will: Architects;
2) Currie and Brown: Project Managers;
3) Elementa: MEP Engineers; and
4) CNM: Structural Engineers.

1.2 Planning Requirements

As part of the planning application for the Project, Camden Council has requested an embodied carbon study to be performed on the proposed and existing buildings. The main aim of this study is to help justify the demolition of the existing structure rather than refurbishing it.

1.3 BREEAM Requirements

In line with planning requirements, the project is being certified under the BREEAM sustainability rating scheme and targeting BREEAM 'Excellent' certification level. As part of the BREEAM strategy, the Project is targeting the MAT 01 Life Cycle Impacts credit. The aim of the MAT 01 credit is reduce the building's environmental life cycle impacts through assessment of the main building elements. This credit helps make choice on materials and gives an incentive to choosing materials with Environmental Product Declarations (EPDs).

2 Methodology

2.1 BREEAM

The BREEAM MAT 01 (hereafter referred to as MAT 01) methodology will be used to perform the embodied carbon study for the Camden Council requirements. Developed by the BRE, this method was found to be the most suitable for the assessment. Both the existing and current building at 150 Holborn will be assessed in the same manner and then compared.

In the case of the Project, the following elements will be assessed;

1) External Walls;
2) Windows;
3) Roof;
4) Upper Floor Slab; and
5) Floor Finishes/Coverings.

The materials mentioned above all belong to the residential, commercial and retail categories of the MAT 01 credit. Internal walls are also studied in the residential category but were ignored in this study due to the large change in the size of the proposed residential area in comparison to the existing.

The MAT 01 calculator can be used to calculate the number of achievable credits for a building. It also gives an output value of kilograms of carbon dioxide equivalent ($kgCO_2eq$). This is the main value which will be used to compare the existing and proposed buildings.

All data used for this study (and subsequently inputted into the MAT 01 calculator) comes from the Green Guide to Specification, also developed by the BRE.

2.2 Green Guide to Specification

The Green Guide, developed by the BRE and part of BREEAM, contains more than 1500 specifications used in various types of buildings. The relative environment impact of construction materials is looked at in six different generic types of buildings including commercial, retail and domestic. The guide provides an extensive list of building specifications covering the most common building materials.

This data is set out as an A+ to E ranking system, where A+ represents the best environmental performance / least environmental impact, and E the worst environmental performance / most environmental impact. BRE has provided a summary environmental rating - The Green Guide rating, which is a measure of overall environmental impacts covering the following issues:

- Climate change;
- Water extraction;
- Mineral resource extraction;
- Stratospheric ozone depletion;
- Human toxicity;
- Ecotoxicity to Freshwater;
- Nuclear waste (higher level);
- Ecotoxicity to land;
- Waste disposal;
- Fossil fuel depletion;
- Eutrophication;
- Photochemical ozone creation; and
- Acidification.

The guide also provides an embodied carbon value for each construction material. The value is in kilograms of carbon dioxide equivalent ($kgCO_2eq$) over a 60 year period. As it is CO_2eq and not just CO_2, the value considers the impact of other greenhouse gases (such as methane) and normalises their effect in units of CO_2. The 60 year scope of the study follows the different materials from manufacturing stage to final disposal at demolition.

It should be noted that the Green Guide is continuously updated to reflect industry environmental impact improvements and standard materials used. This places a limitation on assessing old buildings and assumes they have been built with current industry practices.

2.3 Assumptions

- Due to the constant updates of the Green Guide (as mentioned in the previous section), the existing building is assumed to have been built at the same time as the proposed building will be;

- Due to building being in very early design stage when the study was made, a date was chosen in which the design was frozen (in terms of areas) and the embodied carbon study performed on (8th of January 2016);
- Due to building being in very early design stage when the study was made, most construction materials are yet to have been confirmed. A meeting was held between the sustainability team, architects and project managers to agree on the most probable materials to be used. These materials were then approximated to the closest existing Green Guide construction materials and are assumed to be the correct ones.

3 Embodied Carbon Study – New Building

3.1 Overview

A SketchUp Model provided by the architects was used to measure the areas to be studied. Table 2 gives an overview of the element material specifications, areas and $kgCO_2eq$ contributions. As can be seen from the table, there is a large variation in the Green Guide rating of the materials picked with glazing being D while parts of the solid façade A+.

It should be noted that the Green Guide Calculator was not used in this case to construct custom materials. This is due to the lack of knowledge about which specific materials will be chosen. Instead, default materials were chosen.

3.2 Results

Inputting the information into the MAT 01 calculator produces the following results:

Table 1: Summary of results for proposed building

Element	$kgCO_2eq$ (60 year period)
External Walls	393,141
Windows	992,483
Roof	322,018
Upper Floor Slab	1,434,024
Floor Finishes/Coverings	923,663
Total ($kgCO_2eq$)	4,065,330
Gross External Area (m^2)	19,294
Total Per ($kgCO_2eq/m^2$)	**211**

211 $kgCO_2eq/m^2$ is the embodied carbon of the proposed building for a period of 60 years.

3.3 Discussion

As mentioned previously, a large number of the specifications attached to elements were assumed. A sensitivity analysis will be conducted in the appendix to assess the impact of changes in materials on the final embodied carbon studies.

The MAT 01 calculator also shows the building able to get 10.73 MAT 01 points and 4 out of 5 BREEAM credits (the threshold for 5 out of 5 is 12 MAT 01 points). No information on EPDs was entered into this study which would have further raised the score.

All in all, there is potential for the building to aim for achieving the highest possible number of MAT 01 points and target the exemplary credits. This can be studied further as the design stages progress and more information is available.

Table 2: Overview of proposed building data

	Windows	External Walls	Upper Floor Slab	Roof	Floor Finishes/Coverings
Location	Curtain Wall	Concrete Protruding Façade	Commercial + Retail	Normal Roof (Lower Part)	Normal
Material	Aluminium curtain walling system	Autoclaved fibre cement single sheet and timber battens, breather membrane, insulation, structural concrete frame, cement-bonded particle board, light steel frame, polyethylene sheet VCL, plasterboard on battens, paint	Power floated in situ reinforced concrete floor slab	In situ reinforced concrete slab, vapour control layer, insulation, EPDM single ply roofing membrane	Carpet - Fibre-bonded. 80/20 polypropylene/polyamide, 800 g/m². FCSS 32/33.
Element Number	831500016	1206280009	807280054	1212540016	821570033
Area m^2	4,660	1,998	10,500	800	12,261
Rating	D	A+	C	C	A+
KgCO_2eq/m^2	170.00	75.00	120.00	190.00	69.00
Location	Residential Glazing	Surrounding Walls	Residential	Wooden Deck	Toilets/kitchens
Material	Powder coated aluminium window (profile	Limestone faced precast concrete cladding panel, insulation, light steel studwork, plasterboard,	Power floated in situ reinforced concrete floor slab	In situ reinforced concrete slab, vapour control layer, insulation, Polyester cold applied liquid	UK produced limestone floor tiles.

	Windows	External Walls	Upper Floor Slab	Roof	Floor Finishes/Coverings
	< 1.08 kg/m), double glazed	paint		waterproofing membrane system.	
Element Number	1213100004	806260690	807280054	1212540075	821580009
Area m^2	473	813	1,450	534	1,362
Rating	A	C	C	D	A
$KgCO_2eq/m^2$	250.00	260	120.00	230.00	57.00
Location	Skylight	Balcony Wall		Normal Roof (Upper Section)	
Material	Alumnium window (profile <1.75kg/m), double glazed	Limestone faced precast concrete cladding panel, insulation, light steel studwork, plasterboard, paint		In situ reinforced concrete slab, vapour control layer, insulation, EPDM single ply roofing membrane	
Element Number	1231500009	806260690		1212540016	
Area m^2	632	123		248	
Rating	B	C		C	
$KgCO_2eq/m^2$	130.00	260		190.00	
Total $kgCO_2eq$	**992,483**	**393,141**	**1,434,024**	**322,018**	**923,663**

4 Embodied Carbon Study – Existing Notional Building

4.1 Overview

A set of architectural and structural drawings were provided for the Sustainability Team by the Structural Engineers to be used for estimating the areas of elements in the existing building. The drawings date from the early 80s and include the original drawings for the building. Table 4 gives an overview of the element material specifications, areas and $kgCO_2eq$ contributions. There is also a large variation in the Green Guide rating in this case ranging from A+ in the case of the façade to E in the case of the upper floor slabs.

The two materials comprising the external element were constructed using the Green Guide Calculator due to the availability of enough information on them. Their Green Guide Result sheets can be found in the appendix.

4.2 Results

Inputting the information into the MAT 01 calculator produces the following results:

Table 3: Summary of results for existing building

Element	$kgCO_2eq$ (60 year period)
External Walls	135,789
Windows	338,068
Roof	308,902
Upper Floor Slab	1,240,396
Floor Finishes/Coverings	1,363,151
Total ($kgCO_2eq$)	3,386,305
Gross External Area (m^2)	12,798
Total Per ($kgCO_2eq/m^2$)	**265**

265 $kgCO_2eq/m^2$ is the embodied carbon of the proposed building for a period of 60 years.

4.3 Discussion

As with the proposed building's results, a sensitivity analysis will be done in the appendix to look at the influence of the assumptions. It should be noted that the wall has a very low embodied carbon value per m^2 although it is of very poor performance.

The MAT 01 calculator also shows the building able to get 6.27 MAT 01 points and 2 out of 5 BREEAM credits. No information on EPDs was entered into this study.

Compared to the proposed building, the existing structure would only receive half the number of credits. This also assumes the house was built now rather than in the eighties when the UK's energy mix was different and production less efficient.

Table 4: Overview of existing building data

	Windows	External Walls	Upper Floor Slab	Roof	Floor Finishes/Coverings
Location	Single Glazing	Brick Wall	Concrete Upper Floor Slab	All Roofs	Normal
Material	Steel (cold formed) window, double glazed	Brick, Concrete, Plaster and Emulsion Paint	Screeded in situ concrete slab	Profiled metal "deep" decking with in situ concrete, vapour control layer, insulation, Polyurethane cold applied liquid waterproofing membrane system.	Carpet Tile - polyamide loop or cut tufted, 730 g/m², bitumen backing. FCSS 33.
Element Number	831500002	79900426	807280017	1212540016	821570027
Area m^2	2,113	2,509	8,860	1,626	10,486
Rating	B	A+	E	C	B
$KgCO_2eq/m^2$	160.00	33.53	140.00	190.00	130.00
Location		Metal Covered Wall			
Material		Extruded aluminium cladding rail system			
Element Number		79900427			

	Windows	External Walls	Upper Floor Slab	Roof	Floor Finishes/Coverings
Area m^2		1,001			
Rating		A+			
$KgCO_2eq/m^2$		51.61			
Total $kgCO_2eq$	**338,068**	**135,789**	**1,240,396**	**308,902**	**1,363,151**

5 Conclusions and Summary

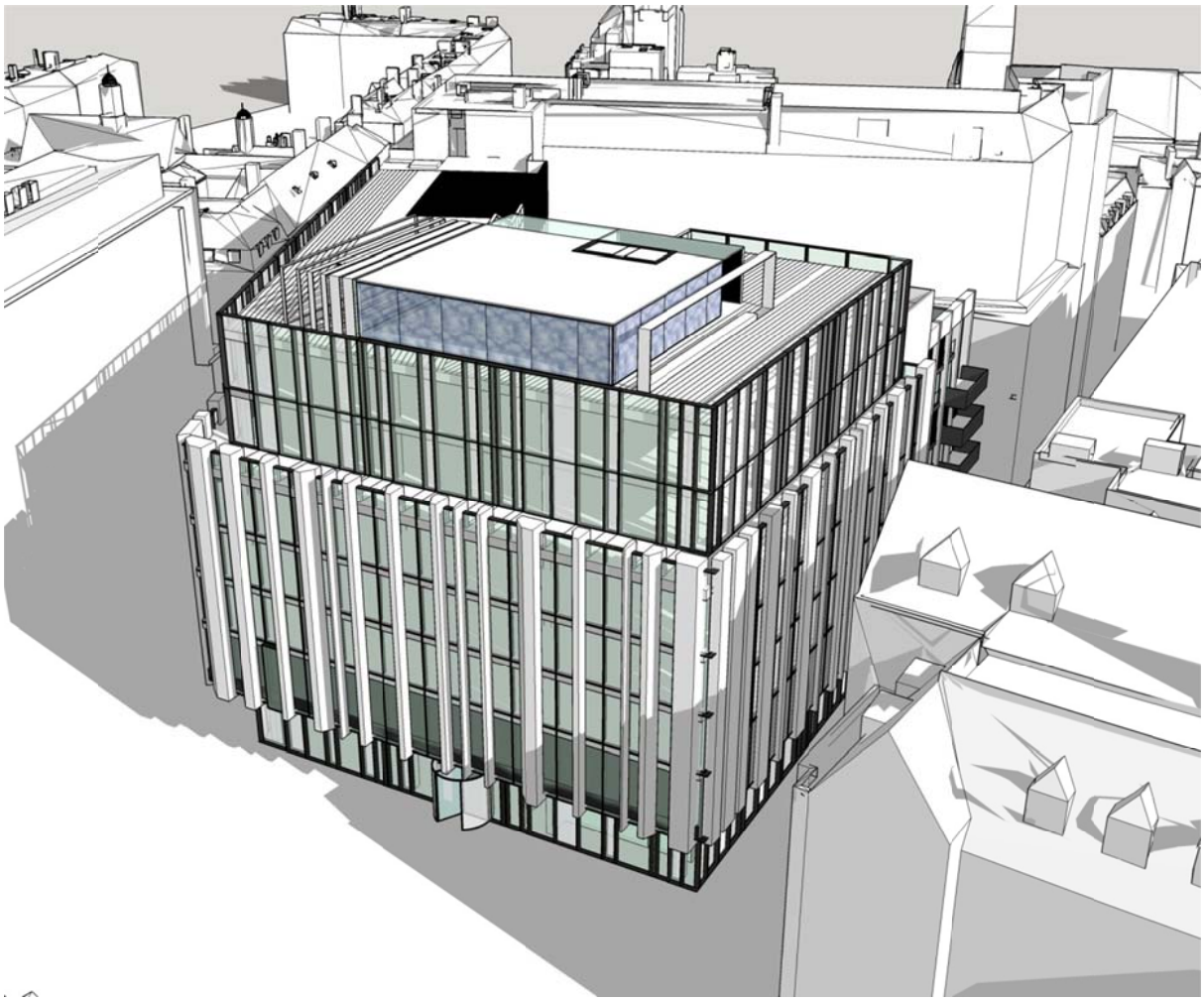
The proposed building's embodied carbon was found to be 20% lower than that of the existing building. It should be noted that the proposed building will have a gross external area around 50% higher than the existing.

An embodied carbon study forms part of a Life Cycle Analysis with Operational Carbon being the other part. The proposed building was designed with reduction in Operational Carbon in mind. It is targeting several energy credits in both LEED and BREEAM and falls under rigorous regulations to ensure it operates with the highest standards. The building's performance and efficiency will be significantly higher than those of the existing.

6 Appendix

6.1 Existing Building Images

6.2 Proposed Building Images



6.3 Sensitivity Analysis

Through conducting a sensitivity analysis on some of the assumptions of the design, the following was observed:

- Reducing the embodied carbon per m^2 of the upper floor slab element (one of the biggest elements in the building) by 50% in the existing building causes the total embodied carbon per m^2 to fall to 216 $kgCO_2eq/m^2$. This is almost equal to the proposed building's value.
- Raising the embodied carbon for the upper floor constructions in the proposed building by 100% causes he embodied carbon per m^2 to rise to 276 $kgCO_2eq/m^2$, a value higher than that for the existing.

This sensitivity analysis is based on two extreme changes but shows significant effects in the final value based on the assumptions inputted. As the design develops and more information becomes concrete, another similar study can be done to assess which building has a lower embodied carbon.