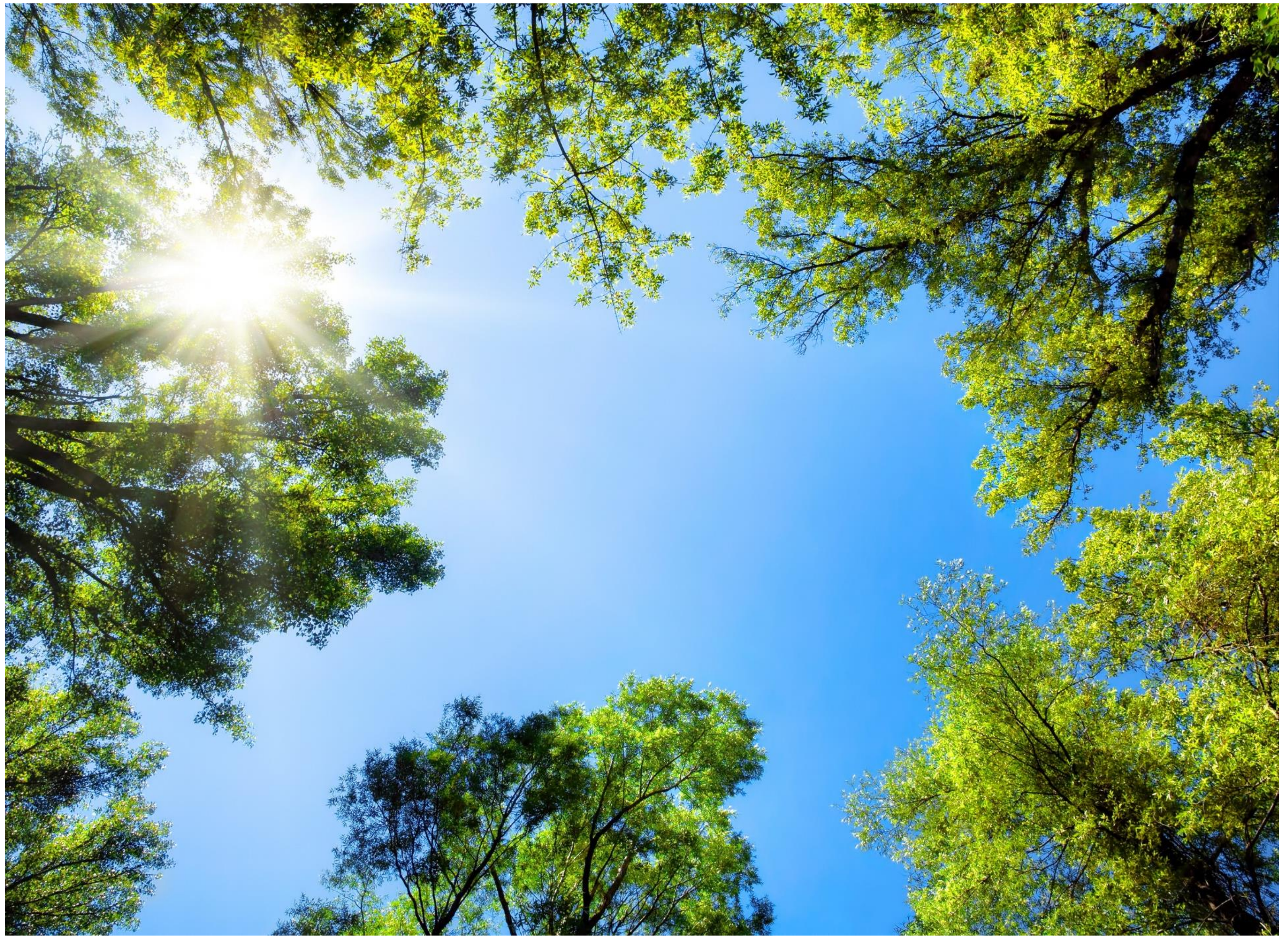

**CAMDEN GOODS YARD**

15112-WAT-XX-XX-RP-V-59002

CGY Whole Life Carbon Assessment

March 2025



# Camden Goods Yards

Property Sustainability Services
Whole Life Carbon Assessment
Stage 2
15112-WAT-XX-XX-RP-V-59002

March 2025

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**Client Name:** St George West London Limited
**Document Reference:** 15112-WAT-XX-XX-RP-V-59002
**Project Number:** BSD15112

## Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS EN ISO 45001:2018)

| Revision | Status | Date | Prepared by | Checked by | Approved by |
|---|---|---|---|---|---|
| P01 | S3 | 21/02/2025 | Talia Levene | Shaun Carpenter | Dr Ankit Singh |
| P02 | S5 | 26/02/2025 | Talia Levene | Shaun Carpenter | Dr Ankit Singh |
| P03 | S5 | 28/02/2025 | Talia Levene | Shaun Carpenter | Dr Ankit Singh |
| C01 | A2 | 28/02/2025 | Talia Levene | Shaun Carpenter | Dr Ankit Singh |
| C02 | A2 | 04/03/2025 | Shaun Carpenter | Dr Ankit Singh | Dr Ankit Singh |

| Comments | |
|---|---|
| P01 | Draft issue for comment |
| P02 | Draft issue for acceptance |
| P03 | Final draft issue for acceptance |
| C01 | For Planning |
| C02 | Updated text to Condition 73, final report for planning |

| Revision | | Status | |
|---|---|---|---|
| P*nn* | Preliminary (shared; non-contractual) | S1 | Coordination |
| C*nn* | Contractual | S2 | Information |
| | | S3 | Review & Comment |
| | | S4 | Review & Authorise |
| | | S5 | Review & Acceptance |
| | | A0, A1, A*n* | Authorised & Accepted (*n*=work stage if applicable) |

## Disclaimer

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# Executive Summary

This Whole Life Carbon Assessment document has been prepared by Waterman Building Services on behalf of St George West London Limited ('the Applicant'), for the Proposed Development. The S73 application will vary the extant planning permission for the Camden Goods Yard project. The Planning Statement provides the full description of the proposal.

This document accompanies the Greater London Authority's Whole Life Carbon (GLA WLC) Assessment Template C, which has been developed to meet the relevant planning Policy SI 2 (F) "Minimising Greenhouse Gas Emissions" of the London Plan and has been produced in accordance with the GLA's Whole Life-Cycle Carbon Assessment Guidance.

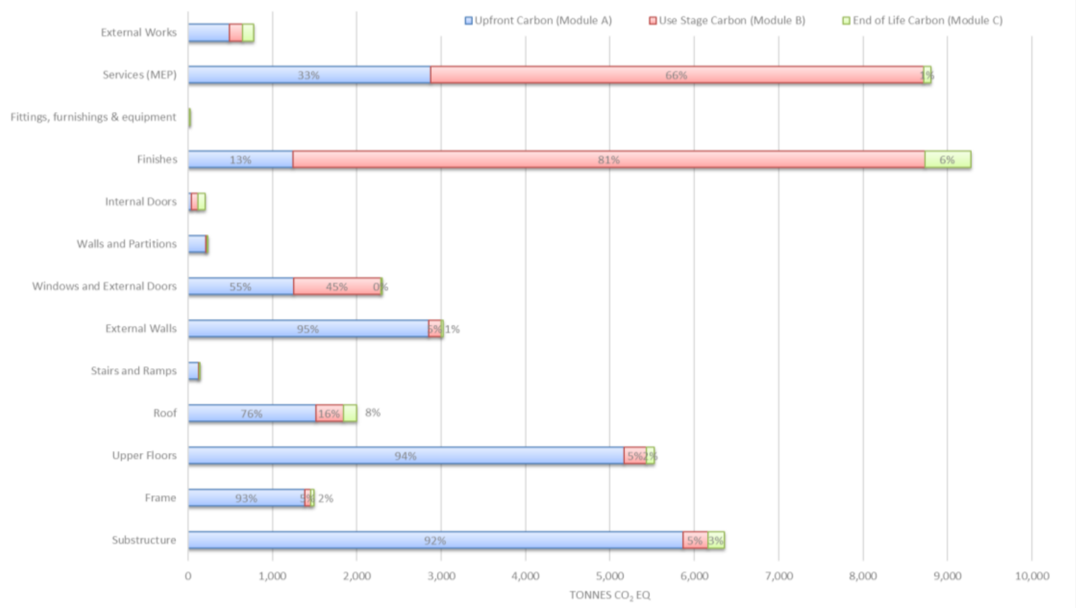
The Whole Life Carbon Assessment has been undertaken in line with the BS EN 15978:2011 and the RICS Professional Statement Whole Life Carbon Assessment for the Built Environment version 1, 2017 (RICS, **Ref. 3**). For any missing information where assumptions have not been described in RICS version 1, the updated RICS version 2 (2023, **Ref. 4**) has been referred to. For the purposes of this report, "RICS" will refer to RICS version 1, unless stated otherwise.

All the building element categories included in this assessment align with RICS and are applicable for the Proposed Development.

The results are based on the current status of the electricity grid and do not include future considerations on the decarbonisation of the grid.

| | GIA ($m^2$) | Overall Carbon tonnes $CO_2eq$ | Carbon per $m^2$ GIA kg $CO_2$ eq/$m^2$ |
|---|---|---|---|
| **Whole Life Carbon** (A - C)* | 93,657 | 53,522 | 571 |
| **Embodied Carbon** (A - C)** | | 40,039 | 428 |
| **Upfront Embodied Carbon** (A1 - A5)*** | | 23,040 | 246 |
| **Operational Carbon** (B6 - B7) | | 13,483 | 144 |

* Includes B6, B7, and Sequestered Carbon
** Excludes B6 and B7, includes Sequestered Carbon
*** Excludes Sequestered Carbon




| Benchmark | Module | Benchmark Target ($kgCO_2eq/m^2$) | Results of the Proposed Development | Benchmark Met? |
|---|---|---|---|---|
| Current | Module A* | < 850 | 246 | **Met** |
| | Module B-C** | < 350 | 183 | **Met** |
| | Total*** | < 1200 | 429 | **Met** |
| Aspirational | Module A* | < 500 | 246 | **Met** |
| | Module B-C** | < 300 | 183 | **Met** |
| | Total*** | < 800 | 429 | **Met** |
| UKNZCBS | Module A (2026) | < 525 | 246 | **Met (complies with 2030)** |

* Excluding Sequestered Carbon
** Excluding B6 and B7
*** Excluding B6 and B7; including Sequestered Carbon

The results of the assessment have been compared against the current and aspirational benchmarks, set by the GLA, for Residential Buildings, as this represents that majority of the Gross Internal Area (GIA) of the Proposed Development. The results meet both the current and aspirational benchmarks for Module A, Modules B-C, and the total embodied carbon impact. The scheme also achieves the UKNZC BS target for 2026 of <525 $kgCO_2e/m^2$.

It should be noted that the Basement and Piling under Buildings B, C, D, and E1 have been constructed from concrete, which has a high embodied carbon intensity. As these elements have already been constructed, they have been excluded from the assessment, and therefore a large portion of construction-based carbon has been omitted, aiding the Proposed Development in achieving the aspirational benchmarks.

As per GLA WLCA guidance and BREEAM v6.1 New Construction Mat01 Credit Criteria, an options appraisal has been done, considering carbon-saving measures already implemented within the scheme and the identification of additional features. Further considerations have been included within Section 5.3.

As a result of submitting the BREEAM v6.1 New Construction Mat01 Assessment tool prior to the planning submission date, 5 credits and 1 exemplary credit would be awarded to the scheme.

The WLC Assessment should be updated at post-construction stage, in line with the GLA WLCA Guidance (**Ref. 2**) and will be based on the actual quantities of materials, products, and systems used for the construction of the Proposed Development. The information gathering requirements should be detailed within the Contractor Requirements.

# 1. INTRODUCTION

## 1.1 Background

This document has been prepared by Waterman Building Services on behalf of St George West London Limited ('the Applicant'), to provide a Whole Life Carbon Assessment for the Proposed Development. The Planning Statement provides the full description of the proposal.

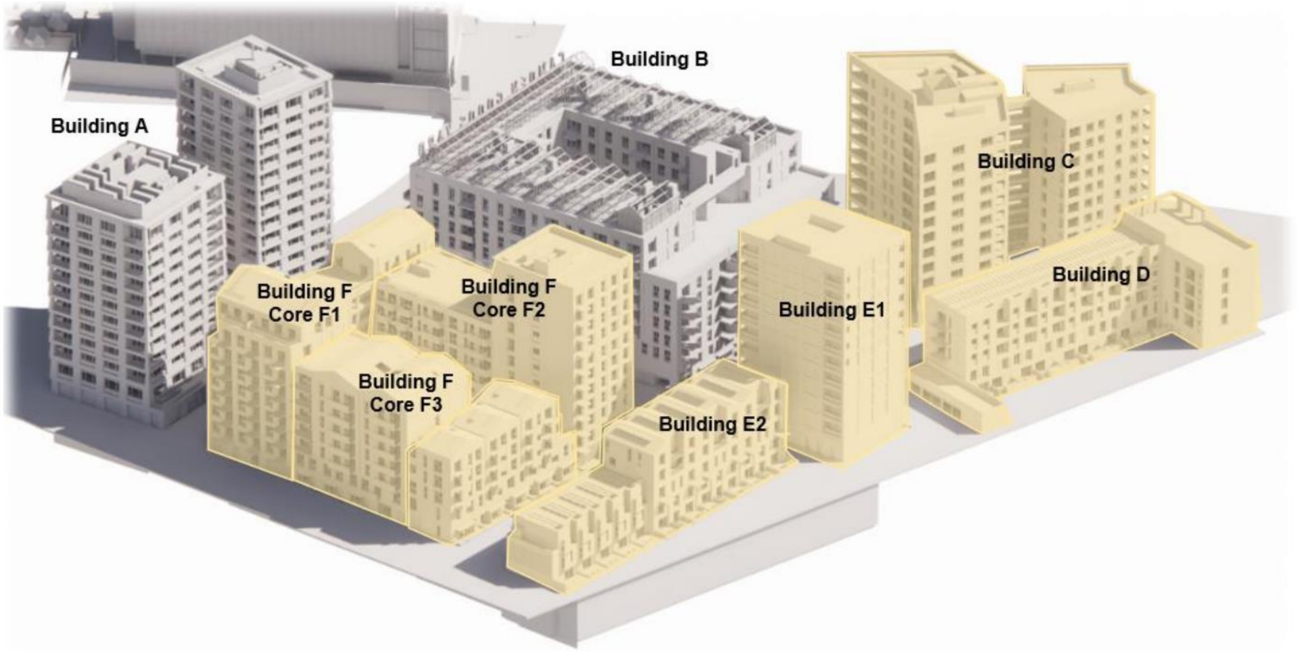
This document has been produced in accordance with the GLA's Whole Life-Cycle Carbon Assessment Guidance (**Ref. 2**) and accompanies the Greater London Authority's Whole Life Carbon (GLA WLC) Assessment Template, which has been developed to meet the relevant planning Policy SI 2 F of the London Plan (**Ref. 1**). The scope of this report is to:

- Outline the scope of the Whole Life-Cycle Carbon assessment.
- Outline the methodology that was followed to complete the GLA WLC Assessment Templates.
- Present and analyse the results of the WLC Assessment of the Proposed Development.
- Compare the results of the WLC Assessment with the corresponding benchmarks that are provided in the GLA's Whole Life-Cycle Carbon Assessment Guidance (**Ref. 2**).
- Provide recommendations for optimisation of the embodied carbon of the Proposed Development.

## 1.2 Site Context

The Site, highlighted in Figure 1, is located on Chalk Farm Road, London, NW1 8EH, within the London Borough of Camden. The Site extends to an area of approximately 3.264 ha and is bounded by Chalk Farm Road to the North, railway lines to the South, the Juniper Crescent HS2 Project Offices to the West, and Regent's Canal to the southeast of the Site.

Figure 1: Blocks forming part of the Proposed Development and S73 Application (shaded yellow)




## 1.3 Proposed Development Description

The Proposed Development comprises proposed amendments in respect of Blocks C, D, E1, E2 and F of the Main Site Parcel, identified in the detail within the DAS Addendum and identified here for ease of reference:

- Insertion of secondary stairs to Blocks C, E1 and F in accordance with fire safety guidelines for residential buildings
- Reduction of affordable housing from 38% to 15% by habitable room (from 203 to 83 homes)
- Minor tenure and unit mix changes to approved plans
- Marginal increase to footprint of Block E1 (0.5m on the east, west and north elevations) to accommodate a secondary staircase
- Minor reduction in heights of Blocks C, D, E1, E2 and F.

The following conditions attached to the Operative Permission control development and are the subject of this S73 Application:

- **Condition 3, 4 and 6 -** approved drawings and documents – these contain drawings which identify affordable homes (references amended) and new drawings are submitted to comply with fire regulations including a second stair core introduced into Blocks C, E1 and F and associated changes.
- **Condition 5** - contains drawings which identify affordable homes (references amended). The condition also refers to the 'affordable housing statement (June 2017)' which is amended.
- **Condition 73** - refers to '203 affordable' homes. This will be revised to '83 affordable homes'. The condition also refers to a total of 27,983sqm GEA of non-residential floorspace. This is revised to 28,792sqm, a de minimis increase of 809sqm following re-measurement of the scheme and marginal building footprint increase to building E1. We also note that the 2,769 sqm GEA of ancillary floorspace (gym, concierge, plant room, parking and energy centre) previously referred to in condition 73 (2020/3116/P, dated 3rd December 2020) has unintentionally been omitted from the Operative Permission and is proposed for reinserted.

It should be noted that redevelopment of the Main Site was granted for the Original Permission 15th June 2018 (application reference: 2017/3847/P). A Pre-Redevelopment Audit and Pre-Demolition Audit were not required for the Original Permission nor the December 2020 (Consented Scheme) and therefore, as Pre-Construction Demolition has already commenced and completed, the associated carbon impacts have been excluded from this Assessment.

This application is accompanied by an addendum to the original Environmental Statement.

Table 1: Housing Quantum

| | Consented | Proposed | Variance |
|---|---|---|---|
| **Total Homes** | 644 | 637 | -7 |
| **Habitable Rooms** | 1,722 | 1,669 | -53 |
| **Private Homes** | 441 | 554 | 113 |
| **Private Habitable Rooms** | 61.9% | 85.3% | 23.4% |
| **Affordable Homes** | 203 | 83 | -120 |
| **Affordable Habitable Rooms** | 38.1% | 14.7% | -23.4% |
| **Private Floor Area ($m^2$ GIA)** | 36,712 | 49,677 | 12,956 |
| **Affordable Floor Area ($m^2$ GIA)** | 19,809 | 8,063 | 11,746 |

Table 2: Non-Residential Floorspace

| Type | Location | Consented* | Proposed |
|---|---|---|---|
| **Retail (A1-A3)** | Main Site | 911 | 904 |
| | PFS | 1,110 | 1,110 |
| **Supermarket (A1)** | Supermarket | 17,709 | 17,709 |
| | Retail Area | 3,786 | 3,786 |
| | Car Park | 8,820 | 8,820 |
| | Back of Operations | 5,103 | 5,103 |
| **Office** | Main Site | 4,078 | 4,077 |
| | PFS | 9,080 | 9,080 |
| **Affordable Office (B1a)** | Main Site | 941 | 941 |
| **Workspace (B1c)** | Main Site | 684 | 717 |
| **Urban Farm (Sui Generis)** | Main Site | 1,304 | 1,304 |
| **Community Space** | Main Site | 74 | 74 |
| **Total** | | **35,890** | **35,917** |

*Main site areas as per 2020 s73 (ref. 2020/3116/P) as amended by NMAs (ref. 2021/3337/P, 2022/4273/P, 2022/5571/P, 2023/1560/P, 2024/2791/P and 2024/4323/P,). PFS areas as per 2023 s73 ref. 2022/3646/P.*

Based on the Proposed Areas shown in Table 1 and Table 2, the Gross Internal Area (GIA) of the Proposed Development has been modelled as 93,657m$^2$

## 1.4 Key Project Team

The key Project Team members, contributing to this Whole Life Carbon Assessment for the Proposed Development is as follows:

Table 3: Key Project Team

| Project Team | Representative |
|---|---|
| Developer | St George West London Ltd |
| Planning Consultant | Quod |
| Architect | Allies and Morrison<br>Piercy and Company<br>Murdoch Wickham |
| Structural & Civil Engineer | Walsh |
| Sustainability and Energy Consultant | Waterman Building Services |
| MEP Consultant | Waterman Building Services |
| Landscape Architect | Murdoch Wickham |

## 1.5 Policy

### 1.5.1 London Plan

National Building Regulations and the Mayor's net zero-carbon target for new development account for a building's operational carbon emissions. As methods and approaches for reducing operational emissions have become better understood, and as targets have become more stringent, these emissions are now beginning to make up a declining proportion of a development's carbon emissions. Attention now needs to turn to WLC to incorporate embodied carbon emissions.

The Mayor's net zero-carbon target continues to apply to the operational emissions of a building. The WLC requirement is not subject to the Mayor's net zero-carbon target for new development but, as set out in London Plan Policy SI 2, planning applicants are required to calculate these emissions, demonstrate how they can be reduced as part of the WLC assessment. Planning applicants should continue to follow the GLA's Energy Assessment Guidance to assess and reduce operational emissions and insert the relevant information into the WLC assessment. This is explained further in the following section.

WLC benchmarks have been developed which the Whole Life Carbon Assessment results shall be compared against and which the GLA will refer to in its review of these assessments. An 'aspirational' set of WLC benchmarks have been devised for applicants that wish to go further.

The London Plan is the statutory Spatial Development Strategy for Greater London prepared by the Mayor of London ("the Mayor"). The London Plan was adopted in March 2021 and includes the following policy in relation to the Whole Life Carbon (WLC) Assessment:

#### Policy SI 2 Minimising Greenhouse Gas Emissions

*"F. Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions."*

#### Information Requirements

The GLA has included a list of information requirements for a Whole Life Carbon Assessment. Most align with the RICS Professional Statement for Whole Life Carbon (**Ref. 3**); however, key notable requirements are listed below:

- Confirmation that options for retaining existing buildings and structures have been explored before considering substantial demolition, including incorporating the fabric of existing buildings into the new development.
- The carbon emissions associated with pre-construction demolition.
- The percentage of new development which will be made up of existing façades, structures, buildings.
- The WLC principles that are informing the development of the site.
- Confirmation that the assessment accounts for a minimum of 95 per cent of the capital cost allocated to each building element category (or an explanation of any omissions).
- An explanation of the third-party mechanisms that have been adopted to quality assure the submission. Allocating the same person, team or organisation to oversee the WLC assessment process from design to post-construction, where possible, would provide consistency in reporting.
- Summary of key actions already implemented in the design to achieve the WLC emissions, including estimated emission reductions to what may otherwise have been specified.
- Opportunities to reduce the development's WLC emissions further.

### 1.5.2 UK Net Zero Carbon Buildings Standard (UKNZC BS)

The UK Net Zero Carbon Building Standard is a market-wide initiative to establish a unified methodology for defining and achieving Net Zero Carbon status in UK Buildings. The Pilot Version, released in September 2024, outlines specific limits and targets for key areas including upfront carbon for a wide range of building use types and encompasses both new and existing structures. By providing a consistent framework, the UK Net Zero Carbon Buildings Standard seeks to eliminate ambiguity around 'net zero carbon' claims in the building industry, promoting genuine efforts toward decarbonisation and supporting the UK's broader climate goals. Table 4 shows the New Build "Homes – Flats" targets, for projects commencing construction between 2026-2032. based on a commencement date of 2026.

Table 4: UKNZC BS Upfront Embodied Carbon Targets for New Build "Homes – Flats"

| Year | Upfront Embodied Carbon A1-A5 ($kgCO_2e/m^2$) |
|---|---|
| 2026 | 525 |
| 2027 | 490 |
| 2028 | 450 |
| 2029 | 420 |
| 2030 | 380 |
| 2031 | 355 |
| 2032 | 335 |

## 1.6 Scope of the Assessment

The Whole Life Carbon Assessment has been undertaken in line with the BS EN 15978:2011 Sustainability of construction works - assessment of environmental performance of buildings - calculation method and the RICS Professional Statement Whole Life Carbon Assessment for the Built Environment version 1, 2017 (RICS, **Ref. 3**). For any missing information where assumptions have not been described in RICS version 1, the updated RICS version 2 (2023, **Ref. 4**) has been referred to. Note that the GLA methodology is based on the RICS version 1 and its methodology and so this is the most appropriate approach to undertaking this assessment at this stage. For the purposes of this report, "RICS" will refer to RICS version 1, unless stated otherwise.

The scope of whole life carbon assessment is to be defined according the below four criteria to allow better comparability between different analyses:

- Life cycle stages i.e. cradle to gate, cradle to practical completion, cradle to grave;
- Building parts, elements and components i.e. substructure, superstructure, finishes, M&E;
- Spatial boundary; and
- Reference study period.

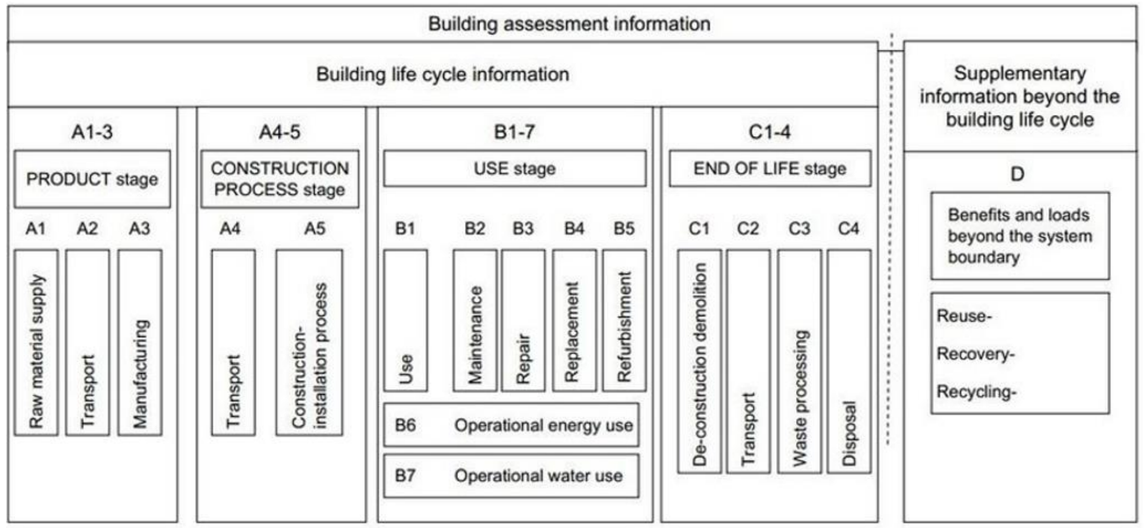
### 1.6.1 Life Cycle Stages

The whole life carbon results will be reported against the following life cycle stages, as per RICS:

- Module A1 – A5 (Product sourcing and construction stage)
- Module B1 – B7 (Use stage)
- Module C1 – C4 (End of life stage)
- Module D (Benefits and loads beyond the system boundary)

These Life Cycle Stages will be reported across a reference study period of 60 years, in accordance with RICS.

Figure 2: Whole Life Carbon Assessment – Project Life Cycle Stages




The embodied carbon estimates from construction and materials include embodied emissions associated with the raw extraction of materials, their manufacturing, transport to the site and construction on site, any replacements assumed over the study period and finally end of life disposal. Benefits and loads beyond the building life-cycle (Module D) are calculated as part of the assessment and reported separately as required by RICS.

The operational carbon relates to the operational energy consumption of the development. This has been calculated for a life-cycle of 60-years based on the assumption that the annual operation energy consumption will remain the same throughout the life-cycle of the project, and is based on operational energy modelling undertaken using the BREDEM methodology for Residential and Part L modelling for Non-Residential.

Table 5 indicates the Life Cycle Stages included in the assessment and the methodology that was followed to calculate the emissions for each of them. There are currently no plans for refurbishment over the next 60-years.

Table 5: Overview of the Life Cycle Modules

| Life Cycle Stages | Notes-Methodology |
|---|---|
| **Product Stage**<br>**A1 – A3** | Quantities were based on information provided by the relevant design team members and emissions were calculated through the One Click database. Details on the calculation and assumptions are provided in the section below |
| **Construction Process Stage**<br>**A4 – A5** | Emissions were calculated based on data from One Click and RICS. The Pre-Construction impacts (A5) associated with the demolition of the existing building, has been calculated based on 50$kgCO_2e/m^2$ (GIA), as per the GLA Whole Life Carbon Assessment Guidance (Paragraph 3.1.4). |
| **Use Phase**<br>**B1** | Emissions were calculated for refrigerant within the Building Services based on CIBSE TM65. |
| **Maintenance**<br>**B2** | Emissions were calculated based on the GLA Whole Life Carbon Assessment Guidance (Paragraph 2.5.12) using 10$kgCO_2e/m^2$ and allocated to each Building Element Category based on the proportion of A1-A5 impacts. |
| **Repair**<br>**B3** | Emissions were calculated based on GLA Whole Life Carbon Assessment Guidance (Paragraph 2.5.12) using a factor of 25% of the B2 emissions. |
| **Replacement**<br>**B4** | Emissions were calculated based on service life data from One Click and RICS. |
| **Refurbishment**<br>**B5** | Excluded as not applicable to the project. There is no planned refurbishment that have yet been decided over the next 60-years |

| Life Cycle Stages | Notes-Methodology |
|---|---|
| **Operational Energy B6** | The energy consumption from the BREDEM and Part L Energy models were used. |
| **Operational Water B7** | Water consumption was calculated using the accommodation schedule and a rate of 110L/person/day for the residential portion of the building, as per Camden Local Plan Policy CC3. |
| **End of Life Stage C1 – C4** | Emissions were calculated based on default data in One Click |
| **Benefits Beyond Life D** | Emissions were calculated based on default data in One Click |

### 1.6.2 Building Elements

Table 6 indicates the in-scope building element categories in line with RICS (Ref. 3) and the building elements categories that are applicable for the Proposed Development. The building element categories are broken down according to the RICS New Rules of Measurement (NRM) classification system Level 2 sub-elements. The last two columns of Table 4 show the building elements that have been included in the assessment and assumptions and comments for each building element category. The information to populate the Bill of Materials was primarily populated from the detailed RFIs provided by the Design Team and corroborated with the detailed Cost Plan. As per GLA requirements, 95% of each building element category by value has been included within this assessment. Please note that as the cost plan is commercially confidential it cannot be shared as part of this submission.

Table 6: Elements Included in the Assessment and the Source of Information

| | Building Element Group | Building Element | | Details |
|---|---|---|---|---|
| | **Demolition** | 0.1 Hazardous Material treatment | N | Not applicable |
| | | 0.2 Major Demolition Works | N | Not applicable |
| 0 | **Facilitating works** | 0.3 & 0.5 Temporary/Enabling Works | N | Not applicable |
| | | 0.4 Specialist groundworks | N | Not quantified |
| 1 | **Substructure** | 1.1 Substructure | Y | Assumed based on the project drawings, and RFI received from the Design Team |
| 2 | **Superstructure (frame)** | 2.1 Frame | Y | Assumed based on the project drawings, and RFI received from the Design Team |
| | | 2.2 Upper floors incl. balconies | Y | Based on RFI received from the Design Team. |
| | | 2.3 Roof | Y | Assumed based on the project drawings, and RFI received from the Design Team |
| | | 2.4 Stairs and ramps | Y | Based on RFI received from the Design Team. |
| 2 | **Superstructure* (façade)** | 2.5 External Walls | Y | Based on RFI received from the Design Team. |
| | | 2.6 Windows and External Doors | Y | Based on RFI received from the Design Team. |
| 2 | **Superstructure* (internal)** | 2.7 Internal Walls and Partitions | Y | Based on RFI received from the Design Team. |
| | | 2.8 Internal Doors | Y | Based on RFI received from the Design Team. |
| 3 | **Finishes** | 3.1 Wall finishes | Y | Based on RFI received from the Design Team. |
| | | 3.2 Floor finishes | Y | |
| | | 3.3 Ceiling finishes | Y | |
| 4 | **Fittings, furnishing and equipment (FFE)** | 4.1 Fittings, Furnishings & Equipment incl. Building-related] and Non-building-related | Y | Based on RFI received from the Design Team. |
| 5 | **Building services (M&E)** | 5.1–5.14 Services incl. Building-related and Non-building-related | Y | Assumed based on the project drawings, and RFI received from the Design Team |
| 6 | **Prefabricated Buildings and Building Units** | 6.1 Prefabricated Buildings and Building Units | N | Not applicable |
| 7 | **Work to existing buildings** | 7.1 Minor Demolition and Alteration Works | N | Not applicable |
| 8 | **External works** | 8.1 External Works | Y | Based on RFI received from the Design Team. |

## 1.7 LCA Software and Database

The WLC Assessment has been conducted using the LCA software OneClick LCA. OneClick LCA is an industry recognised tool that produces results compliant with the international standard EN 159781 and RICS Scope. One Click LCA in approved by the GLA and meets the requirements detailed in the GLA Whole Life-Cycle Carbon Assessment Guidance (**Ref. 2**).

One Click LCA has material life-cycle inventory carbon data that is compliant with EN15804. The One Click LCA platform provides different types of market based LCA data, an overview of which can be seen in Figure 3. All the data in these categories are inspected under One Click LCA's Data Quality Policy.

The material selection on OneClick prioritised generic databases over manufacturer databases, and UK locations were prioritised over EU (general), EU (country specific), and Global databases.

Figure 3: Available LCA Data in One Click LCA

| TYPE OF LCA DATA | WHAT THIS MEANS | EXAMPLES |
|---|---|---|
| 1. PUBLIC EPD DATA | Any EPD published anywhere in the world that has suitable construction sector data | All global EPD programs with construction data |
| 2. PUBLIC LCA DATA | Any LCA data published anywhere in the world that is suitable for construction uses | ICE and EPiC databases |
| 3. ONE CLICK LCA GENERIC DATA – MATERIALS | Generic LCA data for key materials. Can be either country specific or global. All global data is automatically adapted to represent better local manufacturing. | One Click LCA generic material profiles |
| 4. ONE CLICK LCA GENERIC DATA – PROCESSES | Generic LCA data for energy and processes. Energy data is country specific or more detailed. Processes are global or regional. | One Click LCA generic energy profiles |

## 1.8 Assumptions

### 1.8.1 Product Stage (A1 – A3)

The carbon factor of each material is based on the database from which it was sourced. Each database has a record of data entry, whether this is from multiple datapoints, such as the ICE database, or from manufacturer EPDs (Environmental Product Declarations). The material specification has been assumed to follow RICS where not explicitly defined (Table 7):

Table 7: Default Specification for Key Building Materials from RICS

| Material | Details | Specification |
|---|---|---|
| Concrete | Piling | C32/40, 20% Cement Replacement |
| | Substructure | C32/40, 20% Cement Replacement |
| | Superstructure | C32/40, 20% Cement Replacement |
| | Generic Concrete | C16/20, 0% Cement Replacement |
| Steel | Reinforcement Bars | 97% Recycled Content |

| | | |
|---|---|---|
| | Structural Steel Sections | 20% Recycled Content |
| | Studwork / Support frames | Galvanised Steel, 15% Recycled Content |
| Aluminium | Cladding Panels | Aluminium Sheet, 35% Recycled Content |
| | Glazing Frames | Aluminium Extrusions, 35% Recycled Content |
| Plasterboard | Partitioning / Ceilings | Min. 60% Recycled Content |
| Insulation | To Floors, Roofs, and External Walls | PIR |

### 1.8.2 Construction Process Stage (A4 – A5)

Transport distances are aligned with RICS version 2 default figures where applicable. For materials or building elements that are not included in Table 8, the default settings from One Click LCA have been applied.

Table 8: Default Transportation Distances for Key Building Materials

| Transport Scenario | Materials | Km by road | Km by sea |
|---|---|---|---|
| Locally Manufactured | Ready-mix concrete | 20 | - |
| Locally Manufactured | Aggregate, earth, asphalt | 50 | - |
| Regionally manufactured | Plasterboard, blockwork, insulation, carpet, glass | 80 | |
| Nationally Manufactured | Structural timber, structural steelwork, reinforcement, precast concrete | 120 | - |
| European Manufactured | CLT, façade modules | 1,500 | 100 |
| Globally Manufactured | Specialist stone cladding | 500 | 10,000 |

Where available, the waste factors for the materials have been assumed based on RICS version 2. For all other materials, waste factors have been taken from the default values provided within the software.

Table 9: Assumed Waste Factors used for the Model

| Material | Assumed Waste Factor used for the Model |
|---|---|
| Insitu Concrete | 5% |
| Precast Concrete | 1% |
| Steel Rebar | 5% |
| Structural Steel | 1% |
| Brickwork | 6% |
| Plasterboard / Cement board | 4% |
| Steel Studs | 1% |
| Insulation | 7% |
| Paint | 6% |
| Carpet | 6% |
| Windows and Doors | 1% |
| Pipework and Ductwork | 1% |

### 1.8.3 Use Stage (B1 – B5)

Expected material lifespans are aligned with RICS version 2, where applicable (Table 10). For materials or elements not included in the table, the default settings from One Click LCA has been used. The lifespan determines the number of replacements required over the 60 year reference period for the assessment. For example, materials with a lifespan of 60 years or longer, i.e. those with a lifespan matching that of the building, will not need replacing and can therefore be classed as permanent elements, such as structural elements.

Table 10: Indicative Component Lifespans

| Building Part | Building Element/ components | Expected Lifespan |
|---|---|---|
| **Substructure** | Piling and foundations | 60 years (or building lifespan) |
| | Lowest ground floor | 60 years (or building lifespan) |
| **Superstructure: frame, upper floor and roof structure** | Structural elements, e.g. columns, walls, beams, upper floor and roof structure | 60 years (or building lifespan) |
| **Facade** | Opaque modular cladding: | |
| | Rain screens, timber panels | 30 years |
| | Brick, stone, block and precast concrete panels | 60 years |
| | Glazed cladded/curtain walling | 35 years |
| | Windows and external doors: | |
| | Hardwood/steel/aluminium windows | 30 years |
| | Doors | 20 years |
| **Roof** | Roof covering: | |
| | Single-ply membrane | 30 years |
| | Standing seam metal | 30 years |
| | Tiles, clay and concrete | 60 years |
| **Superstructure** | Internal partitioning and dry lining: | |
| | Studwork | 30 years |
| | Blockwork | 60 years |
| **Finishes** | Wall finishes: | |
| | Render/paint | 30/5 years respectively |
| | Floor finishes: | |
| | Carpet/vinyl | 7 years |
| | Stone tiles | 25 years |
| | Raised access floor (RAF) pedestal/tile | 50/ 30 years respectively |
| | Ceiling finishes: | |
| | Substrate/paint | 10 years |
| | Suspended grid (ceiling system) | 25 years |
| **FF&E** | Loose furniture and fittings | 10 years |

### 1.8.4 End of Life Stage (C1 – C4)

Table 11 lists the calculations used to estimate the reusability and recyclability of the materials.

Table 11: End of Life Scenarios Used for Modelling, Including Calculation Methodology

| Material | End of Life scenario | Calculation for Reusability | Calculation for Recyclability |
|---|---|---|---|
| All steel | Steel recycling (96%) | 0% | Mass x 96% |
| Insitu Concrete / Cement board | Concrete crushed to aggregate (for sub-base layers) – loss factor of 0.2% | 0% | Mass x 99.8% |
| Precast concrete/Paving | Rebar separated (2%), concrete to aggregate (loss factor of 0.2%) | 0% | (Mass x 2% x 96%) + (Mass x 98% x 99.8%) |
| Brick/Ceramic | Brick/stone crushed to aggregate (for sub-base layers) – loss factor of 0.2% | 0% | Mass x 99.8% |
| Plastics | Plastic-based material incineration | 0% | 0 |
| Plastic-based Insulation | Plastic-based material incineration | 0% | 0 |
| Non-Plastic-based Insulation | Landfilling for inert materials | 0% | 0 |
| Paint | Landfilling for inert materials | 0% | 0 |
| Lift | Landfilling for inert materials | 0% | 0 |
| Timber | Wood incineration | 0% | 0 |
| Gypsum plasterboard | Gypsum recycling (66%) | 0% | Mass x 66% |
| Aluminium framed windows | Glass containing product recycling (80% glass) | 0% | Mass x 80% |
| Aluminium framed doors | Glass containing product recycling (90% metal) | 0% | Mass x 90% |
| Soils and Aggregates | Backfilling (for inert materials) – loss factor of 0.2% | 0% | Mass x 99.8% |
| Building Services | Metal containing product recycling (90% metal) | 0% | Mass x 90% |

The recyclability for concrete has been estimated accounting for the use of the aggregating machinery, assuming 100 tonnes of concrete can be crushed per day with a load factor of 50% and fuel usage at 60l/h. Finally, assuming 100% of the concrete is crushed with no wastage, the overall reusability is the embodied carbon of said concrete less the carbon impact of the crusher, equating to roughly 99.8%.

The recyclability of gypsum plasterboard has been estimated accounting for the loss factor of plasterboard following deconstruction. Contamination with paint has been assumed to waste 2mm of the plasterboard, equating to 16% of a 12.5mm board. Wastage pertaining to the fixtures to stud walling has been estimated to result in 10% wastage from each. Finally, an allowance of 8% has been given to account for damages relating to dampness, other contamination, and general wastage on deconstruction. This results in a total wastage of 34%. Gypsum is fully recyclable through specialist recycling centres; therefore, the remaining 66% is not reduced further.

### 1.8.5 Refrigerants

The refrigerant has been specified as R410a for the Air Source Heat Pumps (ASHPs), which has a Global Warming Potential (GWP) of 2088 $kgCO_2e/kg$, and R32 for the Fan Coil Units (FCUs), which has a GWP of 675 $kgCO_2e/kg$.

The CIBSE TM65 method has been used to calculate the refrigerant impact. An annual leakage rate of 4% and an End of Life recovery rate of 98% have been used for both ASHPs and FCUs.

As a result, the refrigerant impact has been calculated to be 86,250 $kgCO_2e$, split 84,147 $kgCO_2e$ attributed to B1 and 2,103 $kgCO_2e$ attributed to C1.

## 1.9 Operational Carbon

For the operational energy calculations, the BREDEM modelling was undertaken for Residential and Part L for Non-Residential in accordance with GLA guidance. The operational energy calculations were undertaken using the IESVE simulation software. The operational energy consumption has been calculated for a life-cycle of 60-years, assuming that the annual operation energy consumption remains identical throughout the reference period.

The regulated and unregulated annual energy demand is provided in Table 12 and accounts for:

- Regulated energy use type consumption for heating, cooling, auxiliary, lighting and hot water;
- Unregulated energy consumption estimated using National Calculation Methodology (NCM).

Table 12: Overview of the Regulated and Unregulated Energy Consumption

| | Annual Regulated Energy (kWh/year) | Annual Unregulated Energy (kWh/year) | Total |
|---|---|---|---|
| **Residential** | 622,537.2 | 791,136.2 | 1,413,673 |
| **Non-Residential** | 42,390.94 | 76,910.53 | 119,301.5 |
| **Total** | **664,928.1** | **868,046.8** | **1,532,975** |

The results are based on the current status of the electricity grid and does not include future considerations on the decarbonisation of the grid, in line with the GLA WLCA guidance (**Ref. 2**).

The operational water consumption of the Non-Residential areas of the Proposed Development have not been considered to have significant water usage and therefore the water consumption estimates are based solely on the Residential portion of the scheme.

The operational water consumption of the residential was based upon the local policy target of a maximum of 110 L/person/day. Therefore, based on a total occupancy of 1,069 people, the total annual water consumption of the building is approximately 42,920.35 $m^3$.

## 2. COMPLIANCE WITH REQUIREMENTS

Table 13, below, details the key information requirements of the Whole Life Carbon Assessment, as well as how these requirements have been met.

Table 13: List of GLA WLCA Requirements and How These Have Been Met

| Requirement | How Has This Been Met |
|---|---|
| Confirmation that options for retaining existing buildings and structures have been fully explored before considering substantial demolition, including incorporating the fabric of existing buildings into the new development. | Detailed planning permission was granted on 15th June 2018 (application reference: 2017/3847/P) and subsequently amended by the December 2020 Planning Permission via a S73 application (as amended). As a result, all original existing buildings falling under the scope of this s73 Application have already been demolished, with a significant portion of the basement already constructed. |
| The carbon emissions associated with pre-construction demolition. | A Pre-Redevelopment Audit and Pre-Demolition Audit were not required for the Original Permission or the December 2020 (Consented Scheme) and therefore, as Pre-Construction Demolition has already commenced and completed, the associated carbon impacts have therefore been excluded from this Assessment. |
| The percentage of the new build development which will be made up of existing façades, structures, buildings. | This will be explored further in the detailed design stage. |
| The WLC principles that are informing the development of the site. | The embodied carbon of concrete structure has been minimised as much as possible through cement replacement. A minimum of 20% has been specified for structural concrete elements with further discussions to increase this to 40% currently taking place. |
| Confirmation that the assessment accounts for a minimum of 95% of the capital cost allocated to each building element category (or an explanation of any omissions). | Due to the confidentiality of the cost plan, the Cost Consultant completed the RFI, ensuring that it covers 95% of the total value of each building element category. |
| An explanation of the third-party mechanisms that have been adopted to quality assure the submission. Allocating the same person, team or organisation to oversee the WLC assessment process from design to post-construction, where possible, would provide consistency in reporting. | The WLCA document has been prepared and checked in accordance with Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS EN ISO 45001:2018)<br>A QA process with an assessor that has not been involved in the project has been followed. The QA included the assessment of the following key aspects:<br>• Scope of the assessment in accordance with the GLA Guidance and RICS professional standard.<br>• Material Quantities: correct modelling of all material quantities provided by the design team<br>• Material Specifications: modelling of all materials in One Click LCA in line the material specifications that have been provided by the design team.<br>Assumptions used within the assessment are in line with the RICS professional standard.<br>The QA was undertaken by Dr Ankit Singh, the Director of the Waterman Sustainability Team but not previously involved in the project. Ankit has extended experience in undertaking carbon assessments. |
| Summary of key actions to achieve the WLC emissions reported and the emission reductions they are expected to achieve, including from the retention, reuse and recycling of existing structures and materials that are already on-site. | All sustainability measures will be finalised during the technical design stage and included as part of the Contractor Requirements.<br>Additional options are being assessed, which will be used to influence the design development. |
| Opportunities to reduce the development's WLC emissions further. | Further opportunities have been identified and quantified within the Whole Life Carbon Assessment Appendix. |

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# 3. ASSESSMENT RESULTS

## 3.1 Summary of Results

The Proposed Development has an overall whole life carbon impact of 53,522 tonnes $CO_2eq$, corresponding to 571 $kgCO_2eq/m^2$. This is divided into operational carbon (13,483 tonnes $CO_2eq$, or 144 $kgCO_2eq/m^2$) and embodied carbon (40,039 tonnes $CO_2eq$, or 428 $kgCO_2eq/m^2$).

As the operational carbon will be analysed in greater detail in the Energy Assessment, this report focuses on the embodied carbon.

Table 14: Whole Life Carbon Results, with Operational and Embodied Carbon Results

| | GIA ($m^2$) | Overall Carbon tonnes $CO_2eq$ | Carbon per $m^2$ GIA kg $CO_2$ eq/$m^2$ |
|---|---|---|---|
| Whole Life Carbon (A - C)* | 93,657 | 53,522 | 571 |
| Embodied Carbon (A - C)** | | 40,039 | 428 |
| Upfront Embodied Carbon (A1 - A5)*** | | 23,040 | 246 |
| Operational Carbon (B6 - B7) | | 13,483 | 144 |

* Includes B6, B7, and Sequestered Carbon
** Excludes B6 and B7, includes Sequestered Carbon
*** Excludes Sequestered Carbon

## 3.2 Life Cycle Stages

Table 15 provides an overview of the WLC emission breakdown of the Proposed Development by life cycle stages. Sequestered carbon has been reported separately but included within the A-C total.

Table 15: Breakdown of the WLC by Life Cycle Stage

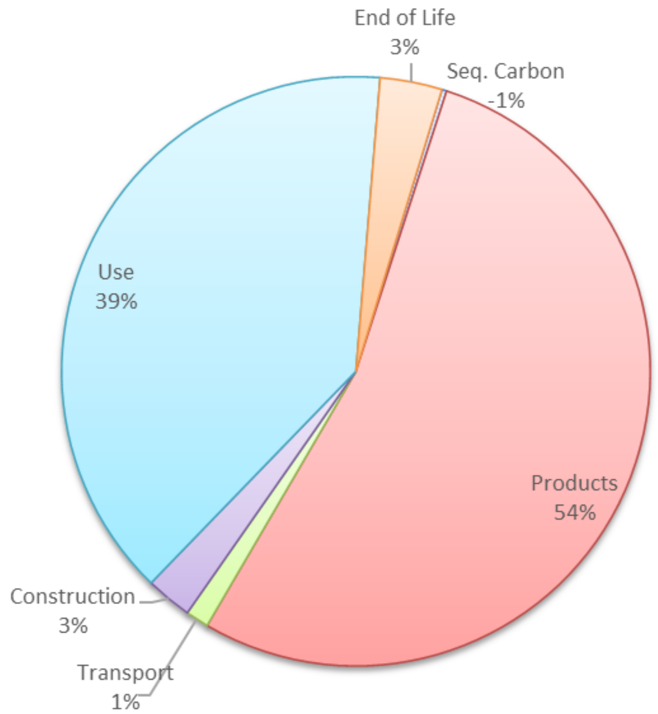
| Life Cycle Stage | | Overall Carbon tonnes $CO_2eq$ | Carbon per $m^2$ GIA kg $CO_2$ eq/$m^2$ | % of total |
|---|---|---|---|---|
| Sequestered Carbon | N/A | -107 | -1 | ~ 0% |
| **Products** | A1-A3 | 21,508 | 230 | 54% |
| **Transport** | A4 | 510 | 5 | 1% |
| **Construction** | A5 | 1,023 | 11 | 3% |
| **Recurring** | B1-B5 | 15,736 | 168 | 39% |
| **End of Life** | C1-C4 | 1,370 | 15 | 3% |
| **Total (excl. Modules B6-B7, D; incl. sequestered carbon)** | A-C | 40,039 | 428 | 100% |
| Benefits Beyond Life | D | -8,517 | -91 | N/A |
| Energy & Water | B6- B7 | 13,483 | 144 | N/A |

As shown in Figure 4, the main embodied carbon impact of the Proposed Development arises from the Product Stage A1-A3, which accounts for 54% of the embodied carbon emissions, whereas the A4 and A5 life stages have a less significant impact (1% and 3% respectively). The Use Phase B1-B5 has the second highest contribution to the building's embodied carbon, accounting for 39% of the overall emissions. The end-of-life emissions C1-C4 are responsible for 3% of the total embodied carbon emissions and a negligible amount is sequestered by "natural" materials.

This trend is as expected, given that the A1-A3 stage comprises the specification of all materials, including carbon-intensive materials such as concrete and steel. A4 and A5 refer to the transportation of materials and construction-based impacts, such as constructuon waste, and therefore will have a much lower impact when compared to the Product Stage. The Use Phase emissions (B1-B5) include the replacement of non-permenant features (i.e., those not expected to endure the full 60 year lifespan), such as building services and windows, and hence includes the product emissions of the replacement materials.

It should be noted that the refrigerant typically contributes a large amount of Use Stage emissions due to the annual leakage and overall charge although, for this project, the impacts have been mitigated by specifying a refrigerant with a lower global warming potential (R32) for the monobloc system, which contains 32kg (approximately 44%) of the total refrigerant charge in the Proposed Development. Compared to using R410a, the use of R32 reduced the B1 carbon emissions from 53,611 $kgCO_2e$ to 17,311 $kgCO_2e$, representing a 67.7% reduction in the refrigerant's carbon impact.

Figure 4: Breakdown of the Embodied Carbon of the Proposed Development by Life Cycle Stage



## 3.3 Building Element Level

Table 16 provides an overview of the breakdown of the embodied carbon emissions of the Proposed Development based on the building element category and life cycle stage.

Table 16: Embodied Carbon Breakdown by Building Element Category and Life Cycle Stage

| Building Element Categories | Embodied Carbon (tonnes $CO_2$eq) | | | | | % of Total |
|---|---|---|---|---|---|---|
| | Seq. Carbon | Module A | Module B | Module C | Overall | |
| Facilitating Works | 0 | 0 | 0 | 0 | 0 | 0% |
| Substructure | 0 | 5,865 | 298 | 199 | 6,361 | 16% |
| Superstructure | -99 | 12,557 | 1,947 | 406 | 14,811 | 37% |
| Frame | 0 | 1,385 | 70 | 36 | 1,492 | 4% |
| Upper Floors | -16 | 5,169 | 269 | 94 | 5,516 | 14% |
| Roof | 0 | 1,514 | 329 | 157 | 2,000 | 5% |
| Stairs and Ramps | 0 | 128 | 7 | 4 | 139 | 0% |
| External Walls | 0 | 2,855 | 146 | 20 | 3,021 | 8% |
| Windows + External Doors | 0 | 1,254 | 1,033 | 10 | 2,298 | 6% |
| Walls and Partitions | 0 | 213 | 14 | 2 | 228 | 1% |
| Internal Doors | -82 | 38 | 80 | 83 | 119 | 0% |
| Finishes | -8 | 1,246 | 7,487 | 543 | 9,269 | 23% |
| FF+E* | 0 | 10 | 4 | 0 | 14 | 0% |
| Services (MEP) | 0 | 2,873 | 5,844 | 89 | 8,806 | 22% |
| External works | 0 | 490 | 155 | 133 | 778 | 2% |
| **Overall** | **-107** | **23,040** | **15,736** | **1,370** | **40,039** | **100%** |

* Fittings, Furnishings, and Equipment

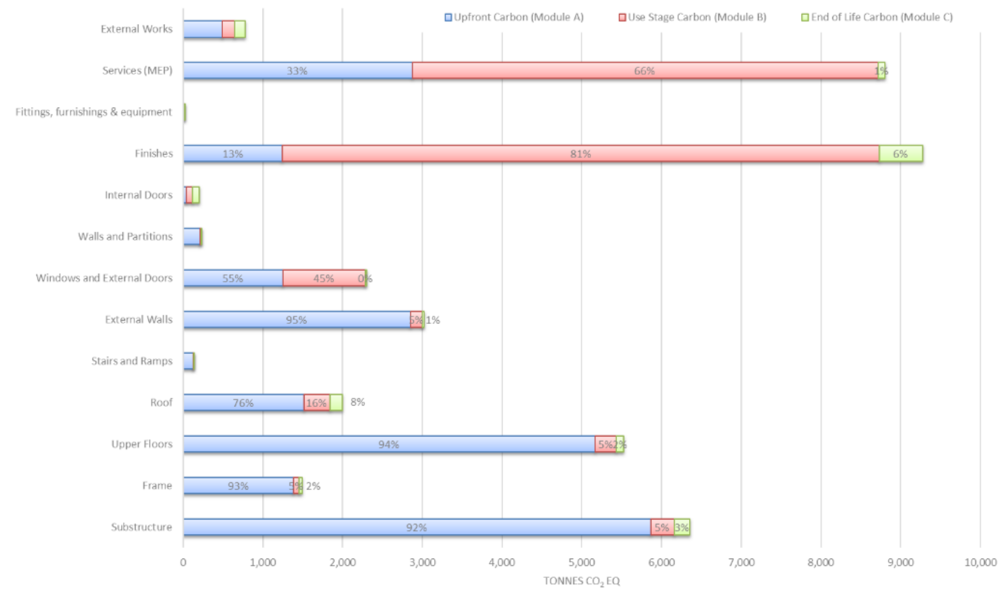
The substructure contributes to 16% of the total embodied carbon impact of the Proposed Development, this is mainly because of piling and foundation which are both constructed from concrete and steel reinforcement, both of which are highly carbon intensive mostly concrete dense. The substructure impact is lower than expected, as the basement and a significant quantity of piles have already been constructed on-Site.

Collectively, the superstructure contributes 37% to the total embodied carbon impact of the Proposed Development. Of this 37%, more than half of the impact arises from the carbon impacts of the structural frame, upper floors, and roof, predominantly from the construction stage due to their permanence within the building.

The second highest contributor to the overall embodied carbon of the scheme is the finishes which account for 23% of the overall emissions. Although the upfront carbon (Module A) is lower than several of the building element categories, the whole life embodied carbon is much higher due to the replacements required over the lifespan of the building.

The Building Services contribute 22% of the total embodied carbon of the development. Most of the emissions (66.4%) of the Building Services is attributed to Module B (only 32.6% is associated with Module A), due to the frequent replacement over the building lifespan and refrigerant leakage.

Figure 5: Embodied Carbon Breakdown by Building Element Category and Life Cycle Stage




## 3.4 Most Contributing Materials

The materials with the highest contribution to the embodied carbon of the building are shown in Table 17. Collectively, these materials are responsible for 58.9% of the overall embodied carbon (A-C) emissions of the building.

Table 17: Overview of the Most Contributing Materials

| Materials | Overall Embodied Carbon ($tCO_2$ eq) | % of Total Embodied Carbon |
|---|---|---|
| Ready-mix concrete | 11,108 | 27.8% |
| HVAC Equipment | 5,944 | 14.9% |
| Rebar | 2,391 | 6.0% |
| Precast cement | 2,073 | 5.2% |
| **Total** | **23,529** | **58.9%** |

To reduce the impacts of these materials, it is important to acknowledge the modelling inputs, summarised in Table 18. These will provide insight into key improvement areas such as embodied carbon factor, replacement rate, and procurement distance.

Table 18: Modelling Inputs for the Most Contributing Materials

| Materials | Modelled Transportation Distance (km) | Database/Manufacturer | Lifespan (years) |
|---|---|---|---|
| Ready-mix concrete | 20 | ICE/OneClick UK Generic | 60 |
| HVAC Equipment | 100 | OneClick EU Generic | 20 |
| Rebar | 120 | OneClick UK Generic | 60 |
| Precast cement | 120 | OneClick UK Generic | 60 |
| Windows | 130 | OneClick UK Generic | 60 |

# 4. COMPARISON OF THE RESULTS WITH BENCHMARKS

## 4.1 GLA Benchmarks

The GLA WLCA Guidance (Ref. 2) requires that the results of the assessment are compared against the benchmarks provided within the document. The GLA Guidance provides two sets of benchmarks, based on the current and “aspirational” embodied carbon performance of the buildings.

The results of the assessment have been compared against the current and aspirational benchmarks, set by the GLA, for Residential Buildings.

The results meet both the current and aspirational benchmarks for Module A, Modules B-C, and the total embodied carbon impact.

Whilst significant reductions have been realised through specifying R32 refrigerant within the scheme, the design team should be looking at opportunities to replace the remaining R410a (GWP 2,088), specified for the larger ASHPs, at later stages.

Table 19: Comparison of the Results with the GLA Benchmarks

| Benchmark | Module | GLA Benchmark ($kgCO_2eq/m^2$) | Results of the Proposed Development | Benchmark Met? |
|---|---|---|---|---|
| Current | Module A* | < 850 | 246 | **Met** |
| | Module B-C** | < 350 | 183 | **Met** |
| | Total*** | < 1200 | 428 | **Met** |
| Aspirational | Module A* | < 500 | 246 | **Met** |
| | Module B-C** | < 300 | 183 | **Met** |
| | Total*** | < 800 | 428 | **Met** |

* Excluding Sequestered Carbon
** Excluding B6 and B7
******* Excluding B6 and B7; including Sequestered Carbon

The Proposed Development demonstrates compliance with the Aspirational set of benchmarks. The Basement and Piling under Buildings B, C, D, and E1 have been constructed from concrete, which has a high embodied carbon intensity. As these therefore fall outside of the scope of this assessment, a large portion of construction-based carbon has been omitted.

Furthermore, it should be noted that significant assumptions had to be made for the Structural items and Building Services, in lieu of information from the Design Team. This therefore presents a level of uncertainty within the results, that should be resolved for subsequent Whole Life Carbon Assessments.

## 4.2 Net Zero Carbon Buildings Standard

The UK Net Zero Carbon Buildings Standard (UKNZC BS) pilot version was released in 2024 and was developed by a wide range of stakeholders in the UK’s Built Environment industry. Included in the standard are upfront embodied carbon limits for a wide range of building use types, for both new and retrofit works, from 2025 until 2050. For Camden Goods Yard, construction is expected to commence in 2026, aligning with a UKNZC BS target of achieving <525 $kgCO_2e/m^2$ for the upfront embodied carbon for New Build “Homes – Flats”.

Table 20: UK NZC Buildings Embodied Carbon Targets

| Year of Completion | UK NZC Target ($kgCO_2e/m^2$) | Results of the Proposed Development ($kgCO_2e/m^2$) | Benchmark Met? |
|---|---|---|---|
| 2026 | 525 | 246 | Yes |
| 2027 | 490 | | Yes |
| 2028 | 450 | | Yes |
| 2029 | 420 | | Yes |
| 2030 | 380 | | Yes |
| 2031 | 355 | | Yes |
| 2032 | 335 | | Yes |

The scheme complies with the 2032 target of 335 $kgCO_2e/m^2$, showing that it is ahead of the required target, as the building's intended year of commencement is 2026.

# 5. OPTIONS APPRAISAL

## 5.1 Measures already included in the Design

In accordance with the GLA WLCA guidance, it is important to acknowledge the measures already incorporated within the design, and quantify the improvement in embodied carbon. Table 21 evaluates these measures.

Table 21: Analysis of measures already incorporated

| Description | Improvement $kgCO_2e/m^2$ |
|---|---|
| Measure 1: CEM1 concrete in the frame | 2 |
| Measure 2: CEM1 concrete in the substructure | 16 |
| Measure 3: All FCU refrigerant pipes to be steel. | 1 |

## 5.2 Description of Further Options

In accordance with the GLA WLCA guidance, options to minimise the embodied carbon impact should be explored. These options should be discussed by the Design Team to determine the viability for inclusion at the next RIBA Stage. It is important to consider that the options proposed are not exhaustive and that other considerations may be explored to further reduce the embodied carbon impact.

Table 22: Option Appraisal with Embodied Carbon Impact

| Description | Improvement $kgCO_2e/m^2$ |
|---|---|
| Option 1: 40% low cement replacement in the frame | 4 |
| Option 2: Specification of CELSA rebar (100% recycled content) throughout the superstructure | 15 |
| Option 3: 40% low cement replacement in the substructure | 16 |
| Option 4: Specification of CELSA rebar (100% recycled content) throughout the substructure | 13 |
| Option 5: Substituting 60mm pavers for natural sandstone | 1 |
| Option 6: Fully wet underfloor heating | 12 |

## 5.3 Further Considerations

### 5.3.1 Products with EPDs / Low Carbon Materials

Specification of products with EPDs (Environmental Product Declarations) enables a comparison to be made between like-for-like products, allowing for a simplified selection process for products with a lower impact. The demand for products with EPDs also assists in creating pressure on manufacturers to lower the carbon impact of their products and report this data for the industry, hopefully driving industry-wide availability of lower carbon building products. Products with EPDs also tend to be lower embodied carbon than industry-average products.

### 5.3.2 Locally Sourced Materials

It is important to source materials locally to reduce transport-related carbon where possible. To further optimise transport emissions, efficiencies such as procuring from the same supplier for different materials should explored.

### 5.3.3 Maximising Recycled Content

Especially for metal-based materials, the recycled content should be maximised where possible to minimise the embodied carbon impact. The recycled content for other materials should be investigated.

### 5.3.4 Reuse Materials and Design for Disassembly

By ensuring that materials can be easily dismantled with minimal damage to surrounding materials, a significant amount of embodied carbon can be saved throughout the Use Stage of the building, especially for interior finishes and building services which are likely to be replaced much more often in a building's lifespan than the other elements. Adhesives and welding should therefore be avoided where possible.

An example that would be applicable for designs such as the one for this study, would be installing recycled plasterboards, which have a significant embodied carbon impact over the cradle-to-grave assessment. There are several companies within London that can recycle plasterboard and several suppliers can offer plasterboard with a high level of recycled content and in turn avoids new virgin materials being created and used.

### 5.3.5 Consideration for Finishes

**Robust materials:** Interior finishes and MEP equipment are replaced multiple times over the building's lifespan. Therefore, ensuring that the materials are robust and can be easily removed and replaced if needed is important in reducing the life cycle carbon impacts from a building. RICS suggests that, for finishes, the replacement occurs every ten years, meaning that a material may be replaced 6 times during the building's 60-year lifespan. It is recommended that the design team investigate methods to increase the lifespan of the finishes to reduce the number of replacements throughout the building lifespan.

**Bare/natural finishes:** If possible, leaving structures and services exposed and having bare finishes will result in a much lower life cycle carbon impact as less material is required (including fewer replacements). In the case of concrete especially, secondary benefits arise as the concrete may act as a thermal mass, reducing operational energy demand, and provide carbonation benefits throughout the building lifespan.

### 5.3.6 Refrigerants

Low carbon refrigerants have already been explored by the team, including R32 ($CO_2$). However, R410a has still been specified in the larger ASHP units. This presents an opportunity to the team to explore substituting this with a lower carbon refrigerant, although care should be given so to not sacrifice operational performance.

Furthermore, the majority of refrigerant-based impacts are attributed to annual leakage and so it is recommended to reduce this wherever possible, by implementing measures such as:

- Frequent leak tests;
- Good maintenance to avoid constant overpressure (which can create small cracks in the coils)
- Installation of pipework with brazed connections rather than flare connections; and
- The use of controls to detect potential leakages.

## 6. BREEAM v6.1 NEW CONSTRUCTION

As part of the Building Certifications for the scheme, a BREEAM v6.1 New Construction Assessment has been undertaken.

As per the Mat01 BREEAM credit requirements, different options of the superstructure, substructure, hard landscaping and building services have been compared:

- 3 significantly different superstructure elemental design options
- 3 significantly different substructure options
- 1 significantly different hard landscaping option
- 2 significantly different building services options

During concept design the differences between these options were at an elemental level, i.e. an entire building element (i.e. frame, upper floor, roof, external walls, windows etc.). At RIBA Stage 4, the current design proposals will be reflected in the BREEAM Mat01 Assessment, and the options appraisal will be at a material level, i.e. the materials that make up certain layers or components of a building element (i.e. cement / cement replacement quantities, steel reinforcement levels, insulation type, different types of render on a façade etc.).

All results from the options appraisal have also been submitted via the Mat01/02 Results submission Tool to BRE prior to the Planning Submission. As a result, **5 credits and 1 exemplary credit can be awarded to the scheme.**

### Superstructure - Options appraisal summary table

Complete rows 'ID 1' and 'ID 2' or more (according to the number of options done) in the following table base on option data files from the 'One Click LCA (LCA for BREEAM UK)' tool. The completed data files shall be saved in the same folder as this file.

| Design option | | Option data file link | m2 net internal area | Kg CO2e/m2 net internal area (60 year study period) | | | | | | | | Description of changes sheet link | Option chosen, and summary reasons for not choosing the other options (Further details provided in description of change sheets) | The following is completed for this option:- - The option data file - The Description of changes sheet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Name | | | 2.1 Frame | 2.2 Upper floors | 2.3 Roof | 2.4 Stairs and ramps | 2.5 External walls | 2.6 Windows and external doors | 2.7 Internal walls and partitions | Total | | | |
| 1 | Mat01_CD_SuperS_Opt1 | Link | 92441 | 14.56 | 53.88 | 19.46 | 1.37 | 8.30 | 23.83 | Not in scope | 121.40 | N/A - 1st option | CHOSEN OPTION | Yes |
| 2 | Mat01_CD_SuperS_Opt2 | Link | 92441 | 16.80 | 53.88 | 19.46 | 1.37 | 8.30 | 23.83 | Not in scope | 123.64 | Link | Prevented another sustainability factor being achieved | Yes |
| 3 | Mat01_CD_SuperS_Opt3 | Link | 92441 | 10.29 | 53.88 | 19.46 | 1.37 | 8.30 | 23.83 | Not in scope | 117.12 | Link | Capital cost >0% and =<10% more than lowest option | Yes |
| 4 | Mat01_CD_SuperS_Opt4 | Link | 92441 | 11.05 | 43.62 | 18.42 | 1.37 | 8.30 | 23.83 | Not in scope | 106.59 | Link | Capital cost >0% and =<10% more than lowest option | Yes |

| | |
|---|---|
| Concept Design option ID chosen ('CHOSEN OPTION' selected): | 1 |
| Question n/a - leave blank. | |
| Options appraised | 4 |
| **Credits awarded** | **4.00** |

### Substructure and hard landscaping - Options appraisal summary table

Complete rows 'ID 5' to 'ID 10' in the following table. The completed data files shall be saved in the same folder as this file.

| Design option | | Option data file link | m2 net internal area | Kg CO2e/m2 net internal area (60 year study period) | | | | | | | | Description of changes sheet link | Option chosen, and summary reasons for not choosing the other options (Further details provided in description of change sheets) | The following is completed for this option:- - The option data file - The Description of changes sheet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Name | | | 1.0 Substructure | 8.2 Roads, paths and pavings | n/a | n/a | n/a | n/a | n/a | Total | | | |
| 5 | Mat01_CD_SubS_HL_Opt1 | Link | 92441 | 104.26 | 7.86 | | | | | | 112.12 | N/A - Substructure 1st option | CHOSEN OPTION | Yes - Substructure |
| 6 | Mat01_CD_SubS_HL_Opt2 | Link | 92441 | 104.26 | 7.86 | | | | | | 112.12 | N/A - Hard landscaping 1st option | CHOSEN OPTION | Yes - Hard landscaping |
| 7 | Mat01_CD_SubS_HL_Opt3 | Link | 92441 | 120.13 | 7.86 | | | | | | 127.99 | Link | Prevented another sustainability factor being achieved | Yes - Substructure |
| 8 | Mat01_CD_SubS_HL_Opt4 | Link | 92441 | 88.39 | 7.86 | | | | | | 96.25 | Link | Capital cost >0% and =<10% more than lowest option | Yes - Substructure |
| 9 | Mat01_CD_SubS_HL_Opt5 | Link | 92441 | 91.35 | 7.86 | | | | | | 99.21 | Link | Capital cost >0% and =<10% more than lowest option | Yes - Substructure |
| 10 | Mat01_CD_SubS_HL_Opt6 | Link | 92441 | 104.26 | 6.80 | | | | | | 111.06 | Link | Life cycle costs too high | Yes - Hard landscaping |

| | |
|---|---|
| Concept Design option ID chosen ('CHOSEN OPTION' selected): | 5 |
| Concept Design hard landscaping option selected: | 6 |
| **Credits awarded** | **1.0** |

### Core building services - Options appraisal summary table (exemplar)

Complete rows 'ID 11' to 'ID 13' in the following table. The completed data files shall be saved in the same folder as this file.

| Design option | | Option data file link | m2 net internal area | Kg CO2e/m2 net internal area (60 year study period) | | | | | | | | Description of changes sheet link | Option chosen, and summary reasons for not choosing the other options (Further details provided in description of change sheets) | The following is completed for this option:- - The option data file - The Description of changes sheet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Name | | | 5.5.1 Heat source | 5.6 Space Heating and Air Conditioning | 5.7 Ventilation | 5.9 Fuel Installations / Systems | n/a | n/a | n/a | Total | | | |
| 11 | Mat01_CD_BdServ_Opt1 | Link | 92441 | 0.00 | 48.83 | 21.73 | 0.00 | | | | 70.56 | N/A - 1st option | CHOSEN OPTION | Yes |
| 12 | Mat01_CD_BdServ_Opt2 | Link | 92441 | 0.00 | 36.86 | 21.73 | 0.00 | | | | 58.59 | Link | Other | Yes |
| 13 | Mat01_CD_BdServ_Opt3 | Link | 92441 | 0.00 | 50.27 | 21.73 | 0.00 | | | | 72.01 | Link | Prevented another sustainability factor being achieved | Yes |

| | |
|---|---|
| Concept Design option ID chosen ('CHOSEN OPTION' selected): | 11 |
| **Credits awarded (exemplar)** | **1.0** |

### Concept Design results

| | |
|---|---|
| **Total credit score at Concept Design:** | **5 + Exemplar credit** |

### Submission of the BREEAM MAT 01/02 Results Submission Tool to BREEAM by the end of Concept Design

Confirm the following (which comprise the BREEAM Mat 01/02 Results Submission Tool) are included and that the submission method is understood:-

| | |
|---|---|
| This file. | Yes |
| The 'Mat01_CD_SuperS_B.xlsx' data file and all the associated option data files (including files that are not used). | Yes |
| The method for submission to BREEAM is to upload to BREEAM Projects. It may not be checked by BREEAM (unless and until the assessment undergoes Q.A). | Yes |
| Date the above sent to BREEAM during Concept Design: | 26/02/2025 |

# 7. POST-CONSTRUCTION WHOLE LIFE CARBON ASSESSMENT

A further WLC Assessment should be completed at the post-construction stage, in line with the GLA WLCA Guidance (**Ref. 2**). The post-construction WLC assessment will be based on the actual quantities of materials, products, and systems used for the construction of the Proposed Development.

These information requirements should be included within the Employer's Requirements as part of the tender package for the Principal Contractors':

- Material specification, including Environmental Product Declarations (EPDs) where available;
- Record of material delivery including distance travelled and transportation mode (including materials for temporary works);
- Waste transportation record including waste quantity, distance travelled and transportation mode (including materials for temporary works); and
- Site energy (including fuel use) record.

The post-construction results will be compared with the planning submission stage results, in line with the GLA WLCA Guidance (**Ref. 2**). Where there is significant difference between the two sets of results explanation will be provided to justify the difference.

## 8. CONCLUSION

This document has been prepared by Waterman Building Services on behalf of St George West London Limited (‘the Applicant’), to provide a Whole Life Carbon Assessment of the Proposed Development at Camden Goods Yard project.

The Proposed Development has an overall whole life carbon impact of 53,522 tonnes $CO_2$eq, corresponding to 571 kg$CO_2$eq/m$^2$. This is divided into operational carbon (13,483 tonnes $CO_2$eq, or 144 kg$CO_2$eq/m$^2$) and embodied carbon (40,039 tonnes $CO_2$eq, or 428 kg$CO_2$eq/m$^2$).

When considering the life cycle modules, the Product Stage A1-A3, accounts for 54% of the embodied carbon emissions. This is to be expected from New Build developments where the permanent, high carbon intensity elements such as the structural frame and upper floors are all new materials. Therefore, building element categories that contain large quantities of these materials, such as the substructure and superstructure (and in particular the structural frame and upper floors) contribute the most to the overall embodied carbon of the scheme.

For building element categories such as Finishes and Building Services, a high proportion of their respective embodied carbon impacts are attributed to the Use Stage, Module B. This is primarily due to the anticipated replacements throughout the 60-year reference period, as well as the refrigerant leakage. The baseline scheme utilises R32 and R410a, which have respective global warming potentials of 675 kgCO2e/kg (59%) and 2,088 kgCO2e/kg (41%), and therefore opportunities arise when investigating refrigerants with lower impacts to replace R410a at the next RIBA Stage.

The results of the assessment have been compared against the current and aspirational benchmarks, set by the GLA, for Residential Buildings. The results meet both the current and aspirational benchmarks for Module A, Modules B-C, and the total embodied carbon impact.

The results of the assessment have also been compared to the UK Net Zero Carbon Buildings Standard benchmark for new build “Homes – Flats”, which allocate upfront embodied carbon targets based on the year of construction commencement. For Camden Goods Yard, the expected year of commencement is 2026, therefore the upfront embodied carbon benchmark is 525 kg$CO_2$e/m$^2$. The results surpass this target, meeting the 2032 target of 335 kg$CO_2$e/m$^2$ instead. It is noted that this is achieved due to the exclusion of already-existing substructure falling out of the scope of this Proposed Development’s assessment.

An options appraisal has been undertaken to comply with GLA requirements and the BREEAM v6.1 New Construction Assessment Criteria, outlining current measures and quantifying the carbon impact associated, as well as proposing further measures for carbon reduction which should be discussed by the Design team in the subsequent Detailed Design Stage. The options that have been assessed are detailed below. Note, further considerations have been included within Section 5.4.

As a result of submitting the BREEAM v6.1 New Construction Mat01 Assessment tool prior to the planning submission date, 5 credits and 1 exemplary credit can be awarded to the scheme.

The WLC Assessment should be updated at post-construction stage, in line with the GLA WLCA Guidance and based on the actual quantities of construction materials, products, and systems used. The information gathering requirements should be detailed within the Contractor Requirements.

## 9. REFERENCES


**Ref. 1** Greater London Authority (2021) the_london_plan_2021.pdf

**Ref. 2** Greater London Authority (2022) LPG document template (green) (london.gov.uk)

**Ref. 3** RICS (2017) Whole life carbon assessment for the built environment 1st edition.pdf

**Ref. 4** RICS (2023) Whole Life Carbon Assessment for the Built Environment 2nd edition.pdf

## Appendices

### A. Whole Life Carbon GLA Spreadsheet – Material Quantities and End of Life Scenarios

| MATERIAL QUANTITY AND END OF LIFE SCENARIOS | | Product and Construction Stage (Module A) | | Assumptions made with respect to maintenance, repair and replacement cycles (Module B) | Material 'end of life' scenarios (Module C) | Benefits and loads beyond the system boundary (Module D) | |
|---|---|---|---|---|---|---|---|
| Building element category | | Material type | Material quantity (kg) | | | Estimated reusable materials (kg) | Estimated recyclable materials (kg) |
| | Note/example | Breakdown of material type in each category [Insert more lines if needed] e.g. Concrete | 65000 kg | For all primary building systems (structure, substructure, envelope, MEP services, internal finishes) including assumed material/product lifespans and annual maintenance/repair % | Declare 'end of life' scenario as per project's Circular Economy Statement, and used in the WLC assessment to produce Module C results | 0 kg | 25 kg |
| | | e.g. Reinforcement | 5000 kg | | | 2 kg | 8 kg |
| | | e.g. Formwork | 250 kg | | | 0 kg | 0 kg |
| 0.1 | Demolition: Toxic/Hazardous/Contaminated Material Treatment | | | | | | |
| 0.2 | Major Demolition Works | | | | | | |
| 0.3 | Temporary Support to Adjacent Structures | | | | | | |
| 0.4 | Specialist Ground Works | | | | | | |
| 1 | Substructure | In-Situ Concrete | 26289177 | As building | Concrete crushed to aggregate (for sub-base layers) - loss facto | 0 kg | 26,236,599 kg |
| | | Steel Rebar | 1158496 | As building | Steel recycling (90%) | 0 kg | 1,042,646 kg |
| | | Aggregate | 326880 | As building | Aggregate reused | 326,880 kg | 0 kg |
| | | Insulation | 4086 | As building | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Plastic Membrane | 6356 | As building | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Blinding | 16344 | As building | Concrete crushed to aggregate (for sub-base layers) - loss facto | 0 kg | 16,311 kg |
| 2.1 | Superstructure: Frame | In-Situ Concrete | 4327937 | As building | Concrete crushed to aggregate (for sub-base layers) - loss facto | 0 kg | 4,319,281 kg |
| | | Steel Rebar | 638835 | As building | Steel recycling (90%) | 0 kg | 574,952 kg |
| 2.2 | Superstructure: Upper Floors | In-Situ Concrete | 19973652 | As building | Concrete crushed to aggregate (for sub-base layers) - loss facto | 0 kg | 19,933,705 kg |
| | | Pre-Cast Concrete | 306306 | As building | Concrete crushed to aggregate (for sub-base layers) - loss facto | 0 kg | 305,693 kg |
| | | Steel Rebar | 1878616 | As building | Steel recycling (90%) | 0 kg | 1,690,754 kg |
| | | Aluminium | 2999 | As building | Aluminium recycling (90%) | 0 kg | 2,699 kg |
| | | Bitumen Membrane | 4118 | 20 | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Insulation | 87.31 | As building | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Steel railing | 11276 | As building | Steel recycling (90%) | 0 kg | 10,148 kg |
| | | Composite boards | 14138 | As building | Wood incineration | 0 kg | 0 kg |
| 2.3 | Superstructure: Roof | Concrete | 3964115 | As building | Concrete crushed to aggregate (for sub-base layers) - loss facto | 0 kg | 3,956,187 kg |
| | | Steel Rebar | 190822 | As building | Steel recycling (90%) | 0 kg | 171,740 kg |
| | | Soil | 38361 | As building | Soil reused | 38,361 kg | 0 kg |
| | | Aggregates | 105216 | As building | Aggregate reused | 105,216 kg | 0 kg |
| | | Concrete Paving | 342240 | 30 | Rebar separated (2 %), concrete to aggregate | 0 kg | 340,885 kg |
| | | Bitumen Membrane | 46202 | 20 | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Insulation | 92150 | As building | Plastic-based material incineration | 0 kg | 0 kg |
| | | Polyethylene vapour membrane | 1156 | 30 | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Galvanised Steel sheet | 6908 | As building | Steel recycling (90%) | 0 kg | 6,217 kg |
| | | Steel decking | 30.67 | As building | Steel recycling (90%) | 0 kg | 28 kg |
| | | Steel railing | 7840 | As building | Steel recycling (90%) | 0 kg | 7,056 kg |
| | | Raised access flooring system | 39516 | 50 | Steel recycling (90%) | 0 kg | 35,564 kg |
| 2.4 | Superstructure: Stairs and Ramps | Concrete | 725801 | As building | Concrete crushed to aggregate (for sub-base layers) - loss facto | 0 kg | 724,349 kg |
| | | Steel Rebar | 30242 | As building | Steel recycling (90%) | 0 kg | 27,218 kg |
| | | Steel Handrail | 1485 | As building | Steel recycling (90%) | 0 kg | 1,337 kg |
| 2.5 | Superstructure: External Walls | Gypsum plaster board | 77790 | As building | Gypsum recycling | 0 kg | 51,341 kg |
| | | Cement board | 2151066 | As building | Concrete crushed to aggregate (for sub-base layers) - loss facto | 0 kg | 2,146,764 kg |
| | | Brickwork | 3099376 | As building | Brick/stone crushed to aggregate (for sub-base layers) - loss fac | 0 kg | 3,093,177 kg |
| | | Render | 4644 | 30 | Cement/mortar use in a backfill | 0 kg | 4,635 kg |
| | | Insulation | 80201 | As building | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Steel | 19297 | As building | Steel recycling (90%) | 0 kg | 17,367 kg |
| | | Aluminium coping | 419 | As building | Aluminium recycling (90%) | 0 kg | 377 kg |
| 2.6 | Superstructure: Windows and External Doors | Aluminium framed windows and doors | 259886 | 30 | Glass-containing product recycling (80 % glass) | 0 kg | 207,909 kg |
| 2.7 | Superstructure: Internal Walls and Partitions | Glass wool insulation | 120061 | As building | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Steel stud | 2558 | 30 | Steel recycling (90%) | 0 kg | 2,302 kg |
| | | Concrete blocks | 275724 | As building | Concrete crushed to aggregate (for sub-base layers) - loss facto | 0 kg | 275,173 kg |
| 2.8 | Superstructure: Internal Doors | Wood Door | 44979 | 20 | Wood-containing product incineration (80% wood) | 0 kg | 0 kg |
| 3 | Finishes | Paint | 5308 | 5 | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Carpet | 16122 | 15 | Plastic-based material incineration | 0 kg | 0 kg |
| | | Ceramic tile | 9340 | 25 | Brick/Stone crushed to aggregate (for sub-base layers) - loss fac | 0 kg | 9,321 kg |
| | | Vinyl | 225636 | 7 | Plastic-based material incineration | 0 kg | 0 kg |
| | | Epoxy | 2813 | 10 | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Gypsum plasterboard | 1330730 | 30 | Gypsum recycling | 0 kg | 878,282 kg |
| | | MDF | 5054 | As building | Wood-containing product incineration (80% wood) | 0 kg | 0 kg |
| | | Screed | 1377243 | As building | Cement/mortar use in a backfill | 0 kg | 1,374,489 kg |
| | | Primer | 325 | 10 | Cement/mortar use in a backfill | 0 kg | 324 kg |
| 4 | Fittings, furnishings & equipment (FFE) | Letter Box | 1662 | As building | Metal-containing product recycling (90 % metal) | 0 kg | 1,496 kg |
| | | Bicycle Rack | 710 | As building | Steel recycling (90%) | 0 kg | 639 kg |
| | | Desk and Drawers | 661 | 10 | Wood-containing product incineration (80% wood) | 0 kg | 0 kg |
| 5 | Services (MEP) | AHU | 12091 | 20 | Metal-containing product recycling (90 % metal) | 0 kg | 10,882 kg |
| | | Acrylics | 13250 | As building | Plastic-based material incineration | 0 kg | 0 kg |
| | | Ceramics | 54017 | 20 | Brick/Stone crushed to aggregate (for sub-base layers) - loss fac | 0 kg | 53,909 kg |
| | | ASHPs | 2970 | 20 | Metal-containing product recycling (90 % metal) | 0 kg | 2,673 kg |
| | | Copper | 14294 | 25 | Copper recycling (90%) | 0 kg | 12,865 kg |
| | | Fire sprinkler | 1084 | 25 | Steel recycling (90%) | 0 kg | 976 kg |
| | | Lifts | 48912 | 20 | Metal-containing product recycling (90 % metal) | 0 kg | 44,021 kg |
| | | FCU | 68280 | 20 | Metal-containing product recycling (90 % metal) | 0 kg | 61,452 kg |
| | | Galvanised Steel | 100678 | As building | Steel recycling (90%) | 0 kg | 90,610 kg |
| | | HDPE | 18180 | 25 | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | LED | 4268 | 15 | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | MVHR | 45655 | 20 | Metal-containing product recycling (90 % metal) | 0 kg | 41,090 kg |
| | | Drinking pipe | 1655 | 20 | Metal-containing product recycling (90 % metal) | 0 kg | 1,490 kg |
| | | PVC | 25697 | 15 | Plastic-based material incineration | 0 kg | 0 kg |
| | | VRF | 10831 | 20 | Metal-containing product recycling (90 % metal) | 0 kg | 9,748 kg |
| | | Thermoset Insulation | 9612 | As building | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | PV | 7500 | 30 | Metal-containing product recycling (90 % metal) | 0 kg | 6,750 kg |
| | | Stone wool insulation | 109852 | As building | Landfilling (for inert materials) | 0 kg | 0 kg |
| | | Underfloor heating | 434610 | 20 | Metal-containing product recycling (90 % metal) | 0 kg | 391,149 kg |
| 6 | Prefabricated Buildings and Building Units | | | | | | |
| 7 | Work to Existing Building | | | | | | |
| 8 | External works | Concrete pavers | 1630746 | As building | Rebar separated (2 %), concrete to aggregate | 0 kg | 1,624,288 kg |
| | | Drainage sublayer | 58370.58 | 30 | Plastic-based material incineration | 0 kg | 0 kg |
| | | Precast pavers | 2256637.34 | As building | Rebar separated (2 %), concrete to aggregate | 0 kg | 2,247,701 kg |

| Refrigerants | | Refrigerant name | Initial Charge(kg) | Annual leakage rate % | Refrigerant GWP ($kgCO_2e/kg$) | End of Life recovery rate % | | |
|---|---|---|---|---|---|---|---|---|
| a | Refrigerants Type 1 (if applicable) - please see CIBSE TM65 for methodology | R410A | 40 | 4% | 2088 | 98% | | |
| b | Refrigerants Type 2 (if applicable) - please see CIBSE TM65 for methodology | R32 | 32 | 4% | 675 | 98% | | |
| c | Refrigerants Type 3 (if applicable) - please see CIBSE TM65 for methodology | | | | | | | |
| | | TOTAL | 74,592,255 kg | | | | 470,457 kg | 72,066,567 kg |
| | | Material intensity (kg/m2 GIA) | 796 kg/m2 GIA | | | | 5 kg/m2 GIA | 769 kg/m2 GIA |

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