WEST CAMBRIDGE

OUTLINE PLANNING APPLICATION

ENVIRONMENTAL STATEMENT ADDENDUM _ VOLUME 1

NON TECHNICAL SUMMARY

UNIVERSITY OF CAMBRIDGE

SEPTEMBER 2017

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Document history

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Rev 2.0	Final	Multiple	DP	PMW	PMW	Sep 17

EIA Quality Mark

This Environmental Statement and the Environmental Impact Assessment (EIA) carried out to identify the significant environmental effects of the proposed development have been undertaken in line with our commitments as members of the EIA Quality Mark.

The EIA Quality Mark is a voluntary scheme operated by the Institute of Environmental Management and Assessment (IEMA) through our EIA activities are independently reviewed, on an annual basis, to ensure we continue to deliver excellence in the following areas:

EIA Management
EIA Team Capabilities
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1. Introduction

1.1 Background

1.1.1 The University of Cambridge is seeking to secure outline planning permission for the development of the West Cambridge site (the Site) for academic and commercial use and associated facilities.

1.1.2 An existing masterplan, which was approved in 1999 (planning application reference C/97/0961/OP) and reviewed in 2004, forms the basis of the current development on the Site. Together with the pre-existing development on the Site, the 1999 masterplan envisages just under 275,000m^2 of development, approximately 47% of which will be academic, 15% research institute and 22% commercial research. The remaining 16% will consist of shared facilities, sports facilities and residential uses.

1.1.3 The academic and residential components have been delivered to the anticipated levels but the extent of commercial research and shared facilities is well below that envisaged in the 1999 masterplan. Policy 18 of the Draft Submission Local Plan supports the densification of the development through a revised masterplan subject to a number of conditions. To inform the Local Plan Examination, the University of Cambridge and Cambridge City Council have agreed a Statement of Common Ground and Addendum, setting out proposed changes to Policy 18, which it is intended would be incorporated in the adopted Local Plan. It is within this context that the University of Cambridge has produced a new masterplan for the Site which will significantly increase the amount of development to approximately 500,000m^2 which includes proposed and existing development on the Site. This masterplan sets out the Proposed Development which was the subject of a planning application submitted to Cambridge City Council in the summer of 2016. Following responses from Cambridge City Council and other stakeholders which expressed concern about the impact of the Proposed Development on the landscape, visual receptors and the setting of listed buildings and conservation areas, the masterplan was amended and a revised planning application was submitted.

1.1.4 The Proposed Development is classed as Environmental Impact Assessment (EIA) development, which means that there is a potential for significant environmental effects to arise as a result of the construction or operation of the development. A planning application for EIA development is required to be accompanied by an Environmental Statement (ES) which reports on the predicted significant environmental effects. An ES was submitted with the original planning application in Summer 2016 and an Addendum to the ES has been submitted with the revised planning application. This ES comprises three volumes which relate to each other as shown in the left hand column of Figure 1.1. To support the amended planning application the ES has been updated and three new volumes produced as shown in the right hand column of Figure 1.1. This document constitutes the revised Volume 1 of the ES, the Non Technical Summary (NTS), and reflects the changes made to the Proposed Development to address the concerns of the initial planning application. This provides a summary of all of the ES documents and replaces the NTS submitted in 2016. The Volume 2 and 3 Addenda are supplementary to the submitted ES and should be read in conjunction with the submitted Volume 2 and 3.

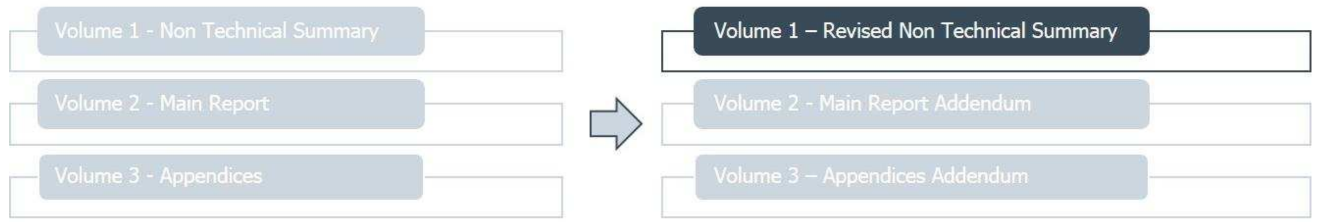

Figure 1.1 Volumes comprising the ES

1.2 Environmental Impact Assessment process

1.2.1 The process for EIA is set out in The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (as amended 2015) (the EIA Regulations) and is summarised in Figure 1.2. New EIA Regulations (The Town and County Planning (Environmental Impact Assessment) Regulations 2017) have subsequently been enacted since the submission of the planning application. Because a Scoping Opinion was obtained under the 2011 Regulations, these are still the determining legislation for the amended planning application.

Screening

The first stage of the EIA is to determine if the project qualifies as EIA development. Broadly if significant environmental effects are likely to arise then it is probable that the project will be considered EIA development.

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Scoping

The second stage of the environmental assessment is to determine what are the likely environmental effects that need to be considered in detail. The scoping stage involves consultation with a variety of stakeholders to obtain their views on what will be assessed.

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Identify existing conditions (baseline)

Once the scope of the environmental assessments has been agreed, the next stage is to identify and describe the existing environment. This is undertaken through a combination of desk based studies using existing information and field surveys.

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Predict and assess likely environmental effects

The next stage is to determine what impacts will arise from the construction and operation of the Proposed Development, and whether any direct or indirect environmental effects from these impacts will be significant. In determining whether an environmental effect will be significant, published guidance has been used where available.

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Develop mitigation measures

Once the environmental effects have been identified, mitigation measures are developed which will seek to minimise significant effects. This is done through either changing aspects of the proposed development design, or construction process, or by compensating for the loss of certain environmental receptors. The preference for mitigation is as follows:

- Preferably avoid the impact; or if not possible
- Reduce the magnitude or scale of the impact; or if not possible
- Compensate for any loss of environmental resources

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Predict residual environmental effects

The environmental effects that will remain after the mitigation measures have been applied are called the residual effects. The predicted environmental effects that are reported in the Environmental Statement are the residual effects having taken into account the mitigation measures.

Figure 1.2 Key stages of the EIA process

1.3 Report authors

1.3.1 Atkins Ltd was commissioned by the University of Cambridge to coordinate the Environmental Impact Assessment for the West Cambridge outline planning application. Atkins Ltd was also responsible for the environmental assessments relating to ecology, landscape and visual impacts, built heritage, and socio-economics. Peter Brett Associates carried out the environmental assessments for traffic and transport, air quality, noise and vibration, ground conditions, and the water environment and Cambridge Archaeology Unit carried out the archaeology assessment.

2. Proposed Development

2.1 The Site and surrounding environment

2.1.1 The Site is located on the western outskirts of Cambridge as shown on Figure 2.1.

2.1.2 It is located to the south of the Madingley Road, one of the main radial routes linking the M11 with Cambridge city centre, and is bounded by residential properties to the east and a Park and Ride car park, residential properties and open land to the north. The M11 forms the western boundary to the Site, beyond which lies agricultural land. Agricultural land bounds the Site to the south.

Description of the Site

2.1.3 The planning application area is 69.4ha whilst the West Cambridge Site is 66ha in area and comprises a mix of land uses including academic, commercial, sports, and residential. The majority of the Site is open land featuring roads and footpaths, car parks, unmanaged plots awaiting development, formal landscaped public realm areas, and large paddocks associated with the veterinary school. There are a number of avenues and individual trees of varying ages across the Site which, combined with the built development, limit cross Site visibility particularly from the eastern side of the Site. There is better visibility across the Site at the western end where views are more open.

2.1.4 Views into the Site along the northern and western boundaries are extremely limited due to thick and dense bands of screening vegetation except where the Site access roads join the A1303 Madingley Road along the northern boundary. Views into the Site from the east are also extremely limited due to a dense band of screening vegetation, but views to the south from the surrounding countryside are slightly more open, though some screening vegetation is still present along the southern boundary.

2.1.5 The Site is divided up and accessed by roads which form a rough grid pattern. There are three main roads crossing the Site in a north-south direction: JJ Thompson Avenue, High Cross Road and Western Access Road. JJ Thompson Avenue and High Cross Site Road both provide access to the Site from the A1303 Madingley Road. A single main road, Charles Babbage Road, crosses the Site in an east-west direction between JJ Thompson Avenue and Western Access Road / Ada Lovelace Road. In addition there are several smaller access roads which service individual buildings and plots.

2.1.6 There are three main clusters of buildings on the Site. The largest cluster of buildings occupies the eastern area of the Site and comprises older buildings constructed in the early 1970s along with contemporary buildings constructed in line with the extant masterplan over the last 15 years. The 1970s buildings include the Cavendish Laboratory complex in the south eastern corner of the Site and the Whittle Laboratory in the north east part of the Site. The modern buildings constructed under the extant masterplan include the Roger Needham Building, William Gates Building, Centre for Advance Photonics and Electronics, Physics of Medicine, Broers Building and Forster Court. This cluster also includes the West Cambridge Nursery, and halls of residence at Franklin Court.

2.1.7 The second cluster of buildings is located centrally on the Site and comprises the Department of Veterinary Medicine. These buildings were mainly constructed in the 1950s and are surrounded by paddocks used by the department. To the south of the Department of Veterinary Medicine and separated by the Charles Babbage Road is the contemporary Alan Reece Building and Department of Materials Science and Metallurgy.

2.1.8 The third cluster of buildings is located in the north western corner of the Site and is used by commercial and research tenants. There are three main buildings built in the late 1970s and early 1980s, each occupied by a different tenant; British Antarctic Survey, Schlumberger, and Aveva. In the south western corner of the Site is the newly constructed University Data Centre.

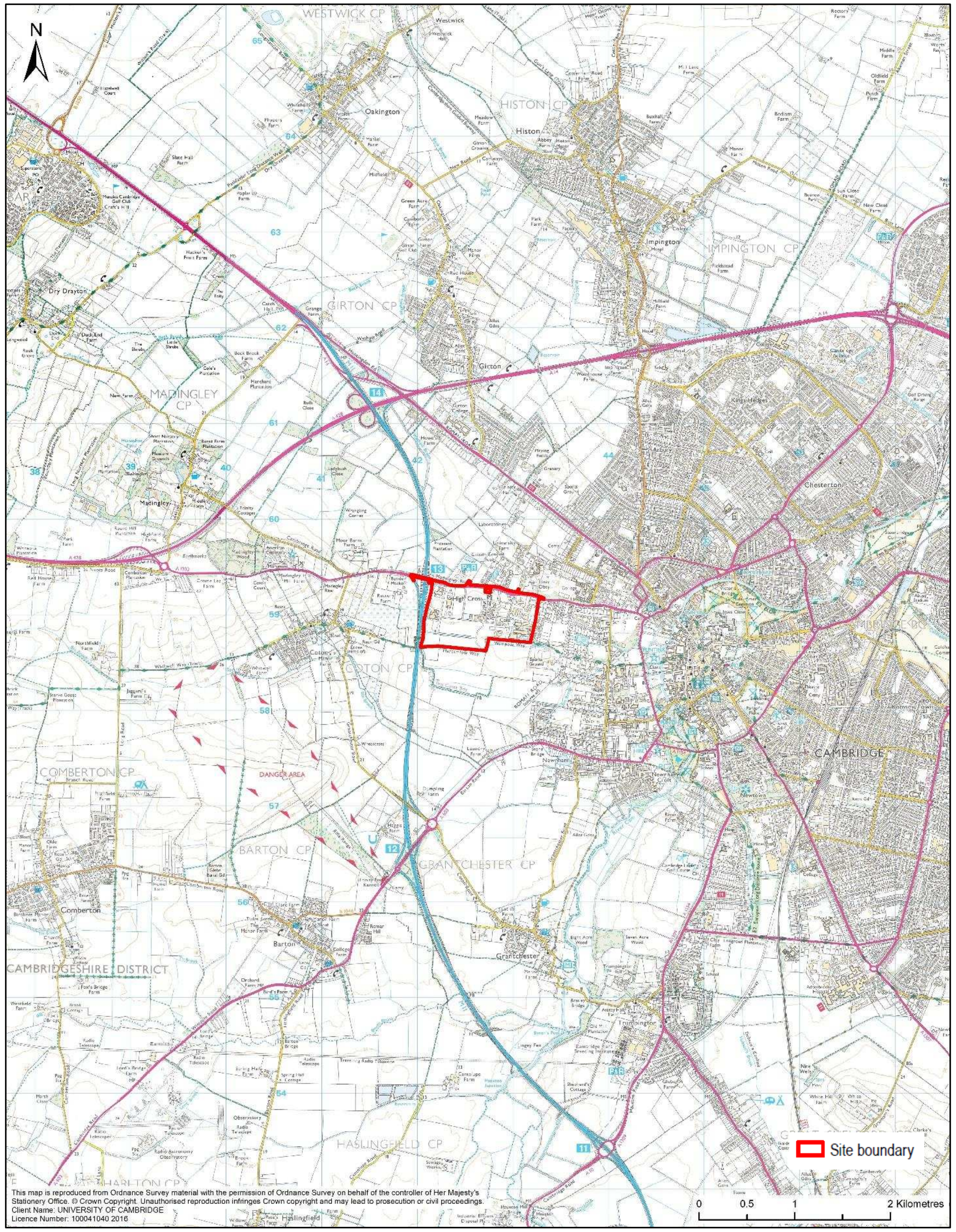

Figure 2.1 Site location

Surrounding environment

2.1.9 The Site is located on the western edge of Cambridge, bounded to the west by the M11 motorway, to the north by the A1303 Madingley Road, to the east by Clerk Maxwell Road and to the south by open countryside.

2.1.10 Residential properties are located close by at The Lawns and Perry Court off Clerk Maxwell Road to the east and Conduit Head Road and Lansdowne Road off the A1303 Madingley Road to the north.

2.1.11 The Madingley Road Park and Ride is located just north of the Site and beyond this are open fields extending to Huntingdon Road which radiates in a north-west direction from the city centre to Huntingdon. These open fields were previously used for agriculture but are now under construction for the implementation of the North West Cambridge development.

2.1.12 Orchards and fields used for agriculture and grazing are located to the west of the M11 and further west of these is the village of Coton. The fields and orchards between Coton and the Site are relatively small and are bound by hedgerows and trees. Fields beyond Coton and to the south are larger and more open. Many are still lined by hedgerows but there are far fewer trees than closer to the Site. This field pattern of large open fields is also present to the south, between the Site and Barton Road, which radiates in a south-westerly direction from the city centre to the village of Barton.

2.1.13 To the east of the Site and beyond the residential properties at The Lawns and Perry Court are the Emmanuel College Recreation Grounds and University Sports Grounds. Beyond these, the western suburbs of Cambridge comprise a mix of residential properties, sports pitches and university buildings.

2.1.14 A long distance recreational route, the Harcamlow Way, passes along a public footpath adjacent to the southern boundary of the Site. Another public footpath branches off the Harcamlow Way further south of the Site. Further south still is another public footpath between Coton and Barton Road.

2.1.15 The Site is located within the impact zone of Madingley Wood Site of Special Scientific Interest (SSSI). Madingley Wood is a small area of ash-maple ancient woodland and is located approximately 1.8km west of the Site. The Site is also located within the impact zones of two geological SSSIs: Histon Road SSSI, located approximately 2.5km north east of the Site, and Traveller's Rest Pit SSSI, located approximately 500m north of the Site.

2.2 The vision for the Site

2.2.1 The University of Cambridge aspires to develop the Site into a high quality academic and research campus.

2.2.2 The University's vision for the Site is to achieve a high quality urban environment that is well integrated with the city centre and surrounding suburbs, as well as emerging developments including the North West Cambridge development. The University's vision comprises five themes which collectively provide the purpose of the Proposed Development:

1. Optimise the amount of development on Site, supporting the city and region as a world leader in research and development.
2. Support the commercialisation of knowledge through entrepreneurship and collaboration with industry.
3. Create and sustain a high quality place by transforming the physical and social environment for Site users and neighbours.
4. Deliver adaptable and efficient space to support viability and long term value creation.
5. Deliver sustainable development, proactively investing in the quality of place and integration within the city.

2.3 Parameter plans

2.3.1 The Proposed Development will support the delivery of the vision through a series of parameter plans, Design Guidelines and a broadly defined description. This will allow flexibility in the description of the development which reflects a key aim of the Proposed Development, to build flexibility into the planning permission, so that the University can respond to changes in academic and commercial demand over the next twenty years or so, without needing to review the outline planning permission or seek a fresh permission.

2.3.2 The parameters for the Proposed Development are described through five parameter plans and their accompanying statements. The plans are:

- Land use;
- Development zones;
- Building heights;
- Access and movement; and
- Open space and landscape.

Land use

2.3.3 Built development will fall into the three land use areas shown in Figure 2.2. The Proposed Development includes the existing land uses on the Site and does not seek to introduce new land uses but rather to revise the extent of permitted land uses on the Site. The largest land use area comprises a mix of academic and commercial uses and includes the existing British Antarctic Survey, Schlumberger and Aveva plots as well as the existing Computer Laboratory, the Roger Needham Building, the CAPE Building and the Physics of Medicine and Maxwell Centre, all of which are to be retained.

2.3.4 The mixed use zone comprises planning use classes A1-A5 (shops, financial and professional services, restaurants and cafes, drinking establishments and hot food takeaways), B1b (commercial research / research institutes) and D1 (non-residential institutions). It includes the South Residences, North Residences and nursery, Hauser Forum and Broers Building, the Institute for Manufacturing, the Chemical Engineering / Biotech Building, the Materials Science and Metallurgy Building, and the Innes Building, all of which are to be retained.

2.3.5 The smallest zone is for community uses and comprises planning use classes D1 (non-residential institutions) and D2 (assembly and leisure). This zone includes the existing sports centre which is to be retained.

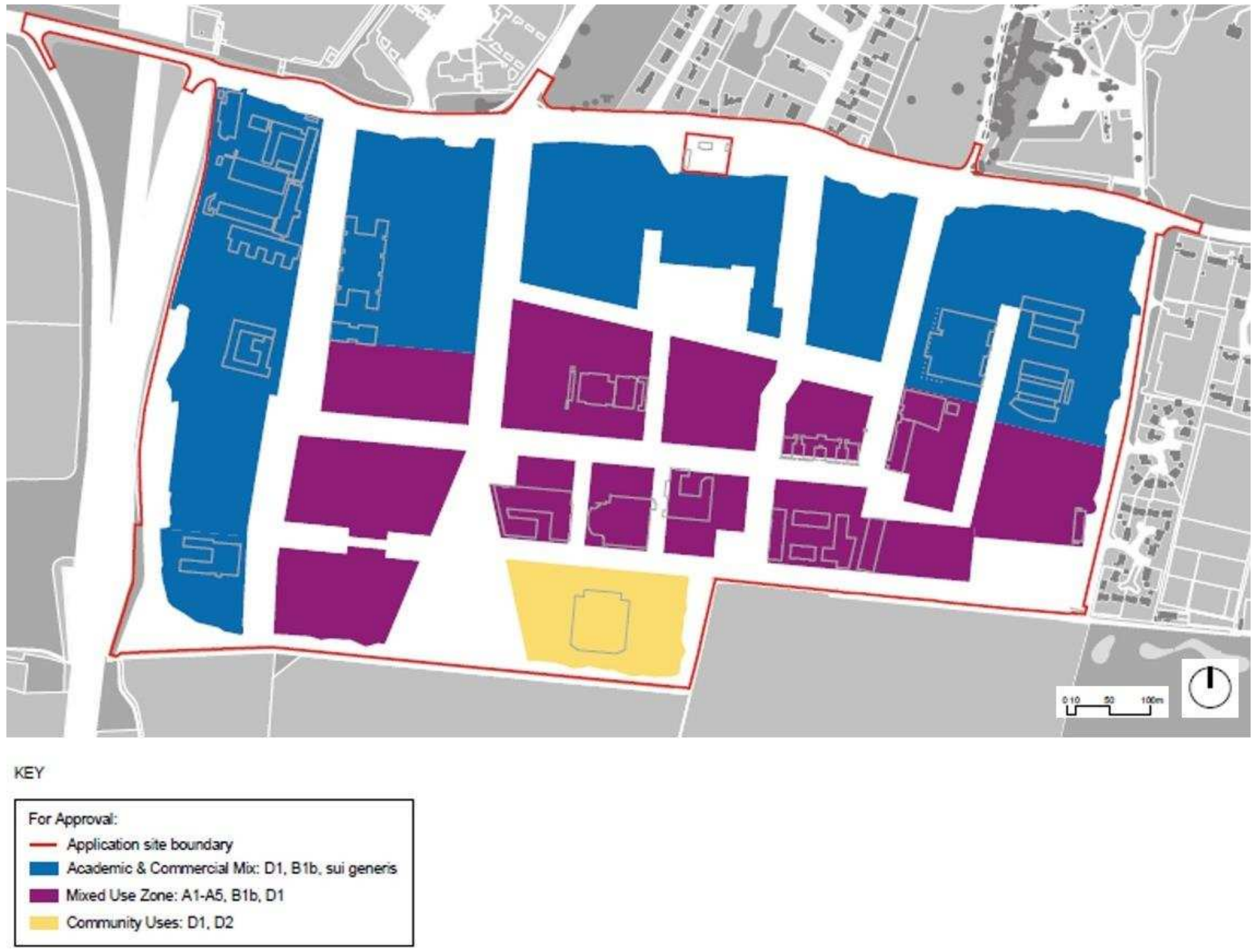

Figure 2.2 Proposed land use

Buildings

2.3.6 Maximum building heights are shown on Figure 2.3. The general building height across the Site will be four storeys for academic / commercial use. Building plant must be included within the height parameters set out on the plan, but exhaust flues may extend above these heights.

2.3.7 The Proposed Development is divided into four development zones as shown in Figure 2.4. Each development zone comprises building zones within which built development will occur including buildings, car parking and vehicular access routes. Development zones exclude existing roads and open spaces which will be retained in the Proposed Development. Table 2.1 shows the maximum developable floorspaces for each development zone and use class.

Table 2.1 Maximum floorspace (m^2) for each use class and development zone

Land use	Academic research	Nursery	Commercial research / research institutes	Shop, café, restaurant , public house	Assembly & leisure (sports)	Ancillary infrastructure (data centre, energy centre)	Total proposed floor space
Use Class	D1	D1	B1b / sui generis	A1 – A5	D2	Sui generis	
Building Zone I	Up to 77,000	Up to 1,500	Up to 21,900	Up to 500	0	0	Up to 77,000
Building Zone II	Up to 38,600	Up to 1,500	Up to 38,600	Up to 300	Up to 4,100	0	Up to 44,500
Building Zone III	Up to 178,400	Up to 1,500	Up to 51,700	Up to 200	0	Up to 2,000	Up to 182,100
Building Zone IV	Up to 104,000	Up to 1,500	Up to 104,000	Up to 500	0	Up to 4,500	Up to 110,500
Total proposed floorspace	Up to 370,000	Up to 2,500	Up to170,000	Up to 1,000	Up to 4,100	Up to 5,700	Up to 383,300

All figures quoted are Gross Floor Area, m^2

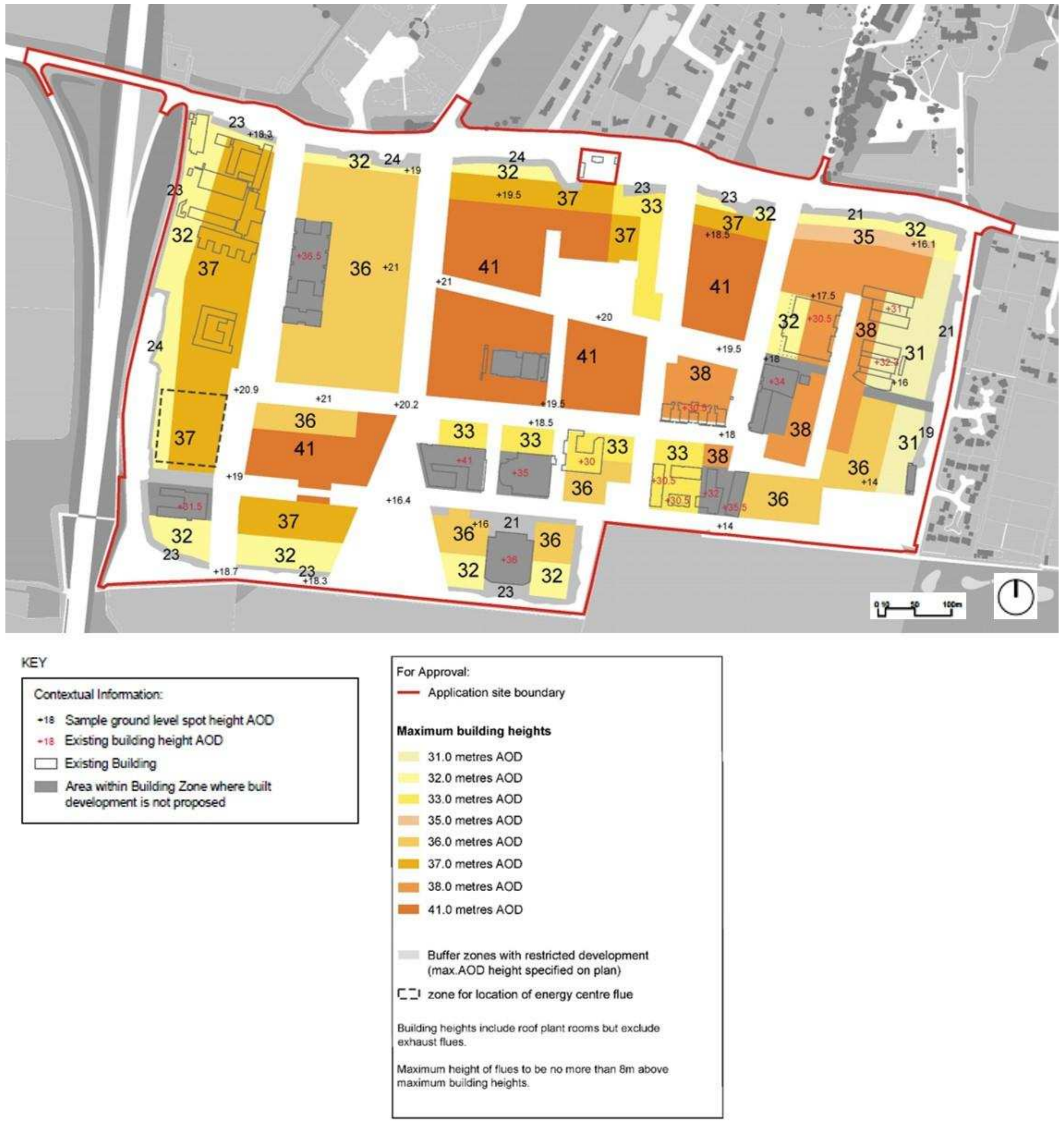

Figure 2.3 Maximum proposed building heights

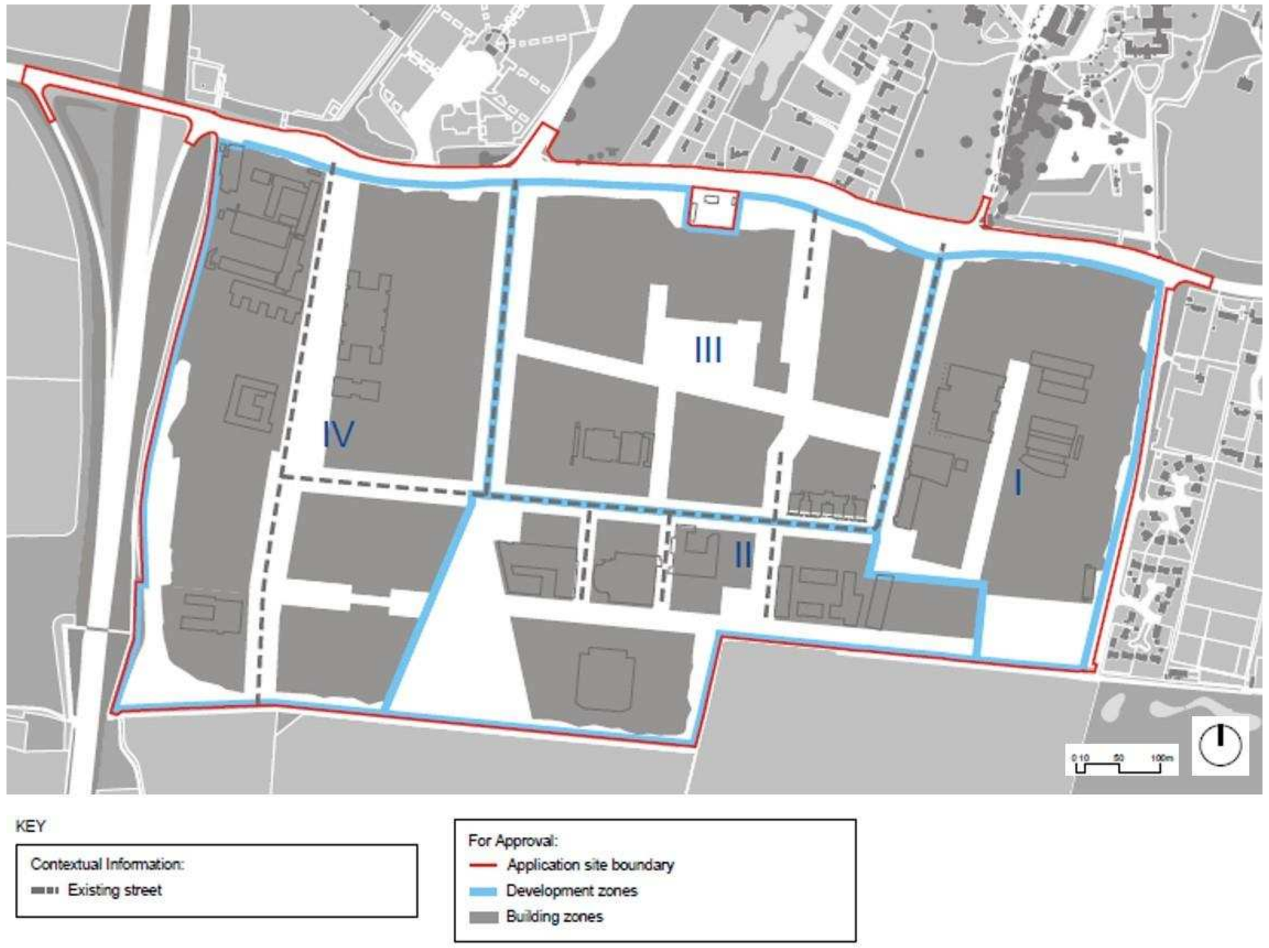

Figure 2.4 Development zones

Access and movement

2.3.8 The proposed access and movement strategy on the Site is illustrated in Figure 2.5. Access to the Site will be from the north, off Madingley Road, and from the east, off Clerk Maxwell Road. The four main roads on site (JJ Thompson Avenue, Charles Babbage Road, High Cross, and Western Access Road) will all be retained and used as the principal means of vehicular access to and across the Site. Additional secondary roads will be constructed to enhance vehicular connectivity. All existing and new vehicle routes and accesses will also allow for pedestrian and cycle movements.

2.3.9 A new pedestrian and cycle access point will be created off Madingley Road. The existing pedestrian and cycle access points along Clerk Maxwell Road will be maintained and will be the main arrival points for cyclists and pedestrians travelling from the city centre. The primary pedestrian and cycle routes through the Site include the existing pedestrian and cycle path running adjacent to the southern boundary (Coton footpath). This will be extended to continue across the Site to the western boundary. A second east-west pedestrian and cycle route will provide access from the existing entrance, approximately halfway along Clerk Maxwell Road, continuing westwards across JJ Thompson Avenue and through a new open space corridor linking up with Highcross Road. A north-south route will extend from the West Forum and along Highcross Road where the route will continue northwards towards the North West Cambridge development. Additional secondary pedestrian and cycle routes will increase connectivity through the Site.

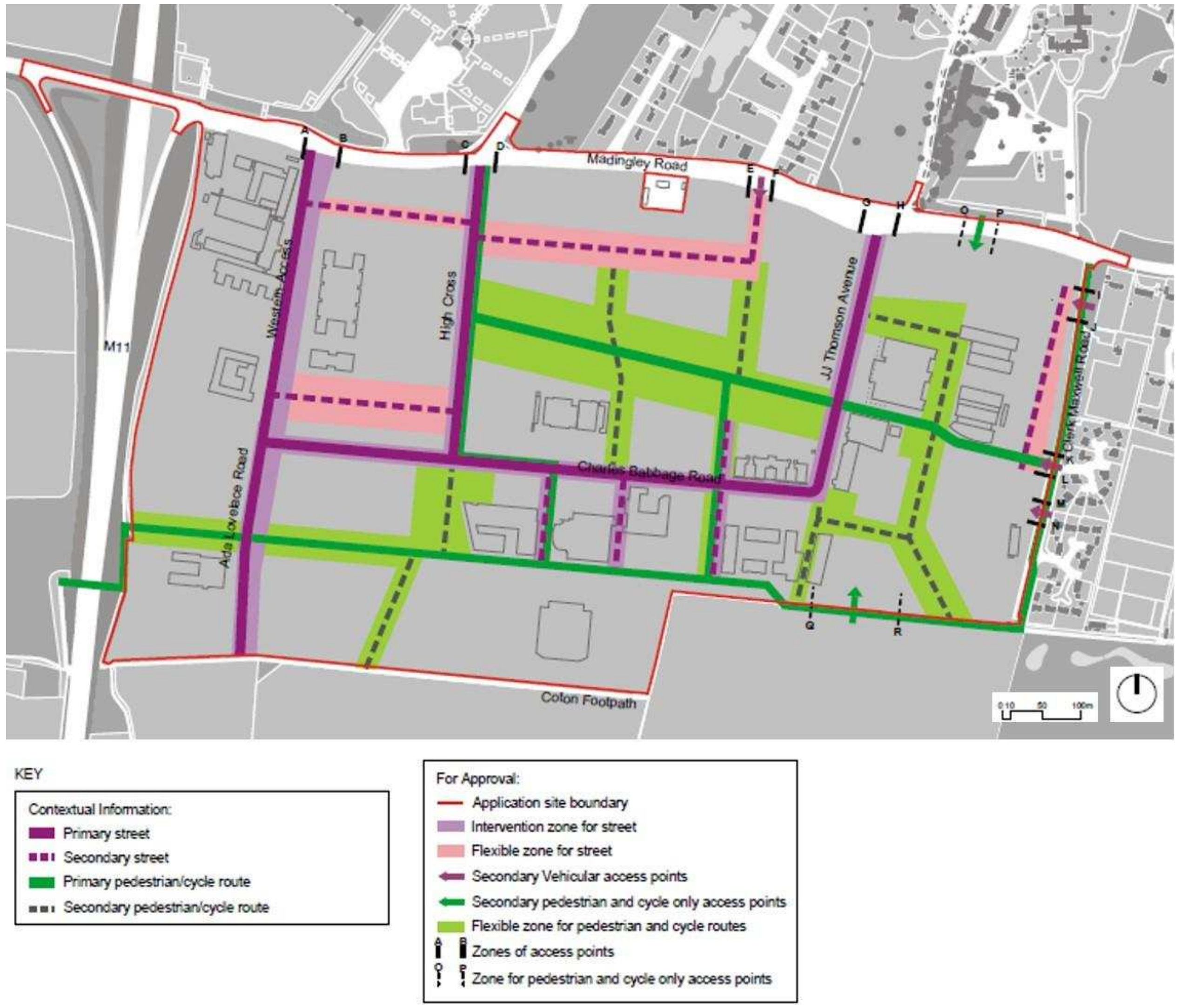

Figure 2.5 Access and movement strategy

Open space and landscape

2.3.10 A series of open spaces and corridors will feature in the Proposed Development as shown in Figure 2.6. The open space network will provide a variety of uses including informal recreation and outdoor entertainment, landscaping, surface water drainage, nature conservation and pedestrian and cycle routes.

2.3.11 Detailed design of the open space areas will be agreed through the submission of reserved matters applications pursuant to the outline planning permission, if granted.

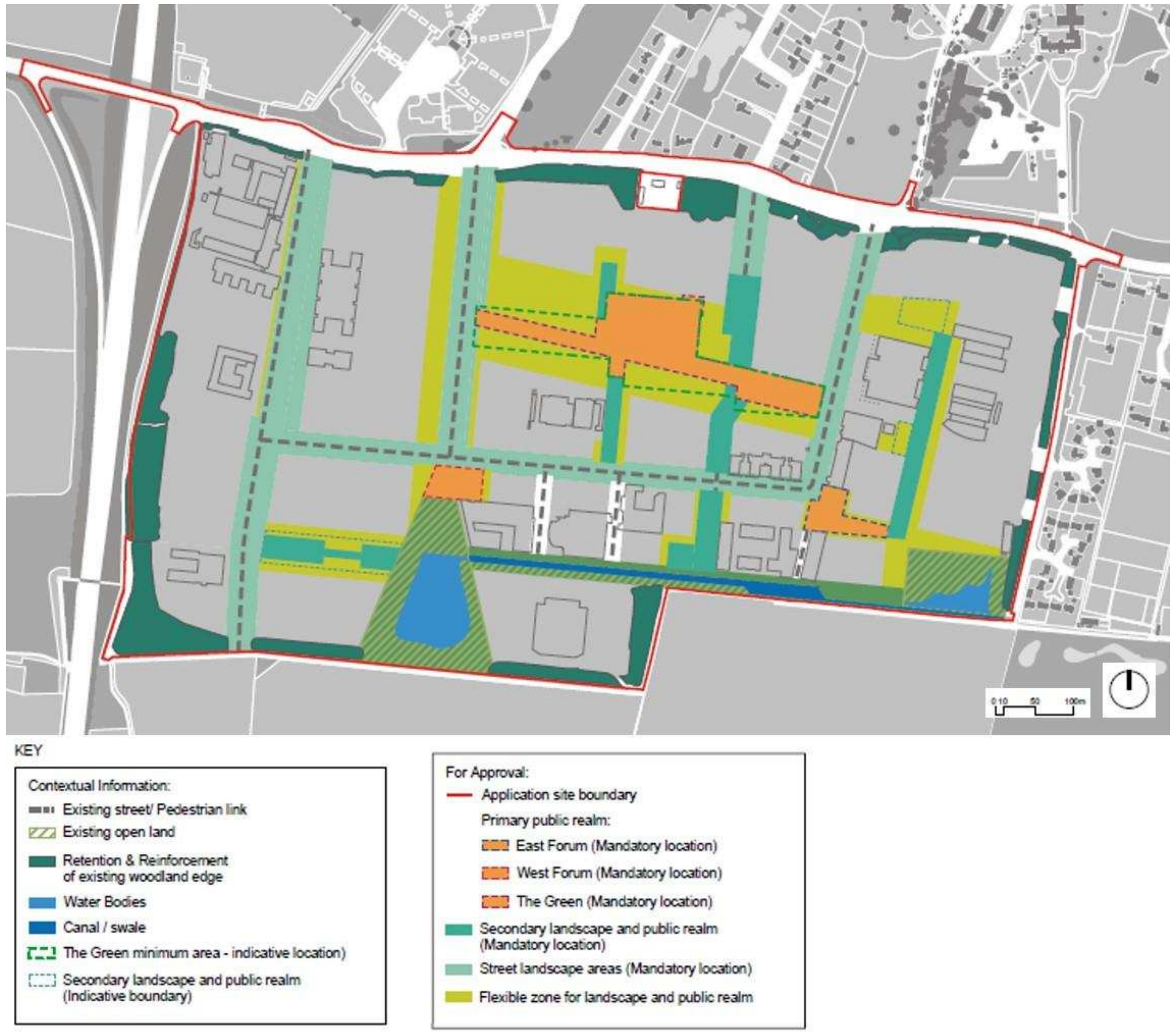

Figure 2.6 Open space and landscape strategy

Infrastructure

2.3.12 An energy strategy for the Proposed Development includes an energy centre that will have a combined heat and energy plant fuelled by gas. This plant will generate sufficient power and heat to meet the requirements of the Proposed Development. The energy centre will be located to the west of the Site as indicated on Figure 2.3.

2.3.13 The drainage strategy is based on discharging all surface water runoff to Coton Brook to the south of the Site and Washpit Brook to the north. Greenfield discharge rates will be achieved through temporary storage on individual building plots and by enlarging the existing surface water bodies on the Site.

Built-in mitigation

2.3.14 In addition to the restrictions contained in the parameter plans the Proposed Development will comply with Design Guidelines which comprise design principles which seek to provide consistency in design. Like the parameter plans, the Design Guidelines are submitted for approval by Cambridge City Council.

2.3.15 The Design Guidelines set out a number of environmental mitigation measures that are 'built-in' to the Proposed Development and which will be secured through the planning permission. These measures are as follows:

- Controls on building design to minimise bulk;
- Controls on boundary planting to improve screening and soften urban edges;
- Measures to strengthen the ecological benefits of the existing ecological corridor;
- Controls on rooftop plant;
- Landscape design guidelines to strengthen other green corridors, including tree planting in streets; and
- Landscape design guidelines to ensure the amenity value of proposed new spaces.

2.3.16 The Design Guidelines also identify a number of trees that are key to the landscape of the Site due to their age, condition, or prominence and will be retained. These trees are shown on Figure 2.8, whichalso shows trees which 'shall' be retained. These are trees for which there is an intention to keep but should development require their removal, this would be permitted under the provisions of the planning permission.

Construction

2.3.17 Construction works will be phased over approximately 15 years. As the details of the construction works are not currently known a number of assumptions have been made, based on previous developments of a similar scale and type, to enable the assessment of environmental effects during construction to be assessed. These assumptions relate to:

- Enabling works including Site clearance and the establishment of a construction compound and worksites;
- Building demolition;
- Contaminated land remediation (if required);
- Earthworks to obtain the desired ground level (these are likely to be minimal);
- Excavation for foundations, services, basements etc;
- Import of construction materials, plant, and workers;
- Stockpiling and storage of construction materials and plant including fuels and chemicals;
- Concrete batching;
- Installation of new services;
- Erection of new structures and buildings;
- Piling for some structures and building foundations;
- Export of construction waste; and
- Landscaping including planting of soft landscaped areas and areas for ecological mitigation.

2.3.18 One of the known construction activities is the requirement to demolish a number of the existing buildings on Site. The buildings scheduled for demolition are listed below and shown in Figure 2.7:

- Cavendish Laboratory complex;
- Whittle Laboratory buildings;
- Department for Veterinary Medicine complex;
- University stores; and
- Merton Hall Farmhouse.

2.3.19 All other existing buildings on the Site will be retained and integrated into the Proposed Development.

2.3.20 A Construction Environmental Management Plan (CEMP) has been submitted in support of the outline planning application. This sets out how mitigation measures for the construction phase identified in the ES will be implemented. When a contractor is appointed for the first development on site a detailed CEMP will be prepared to cover that development. Additional CEMPs will follow for later detailed proposals.

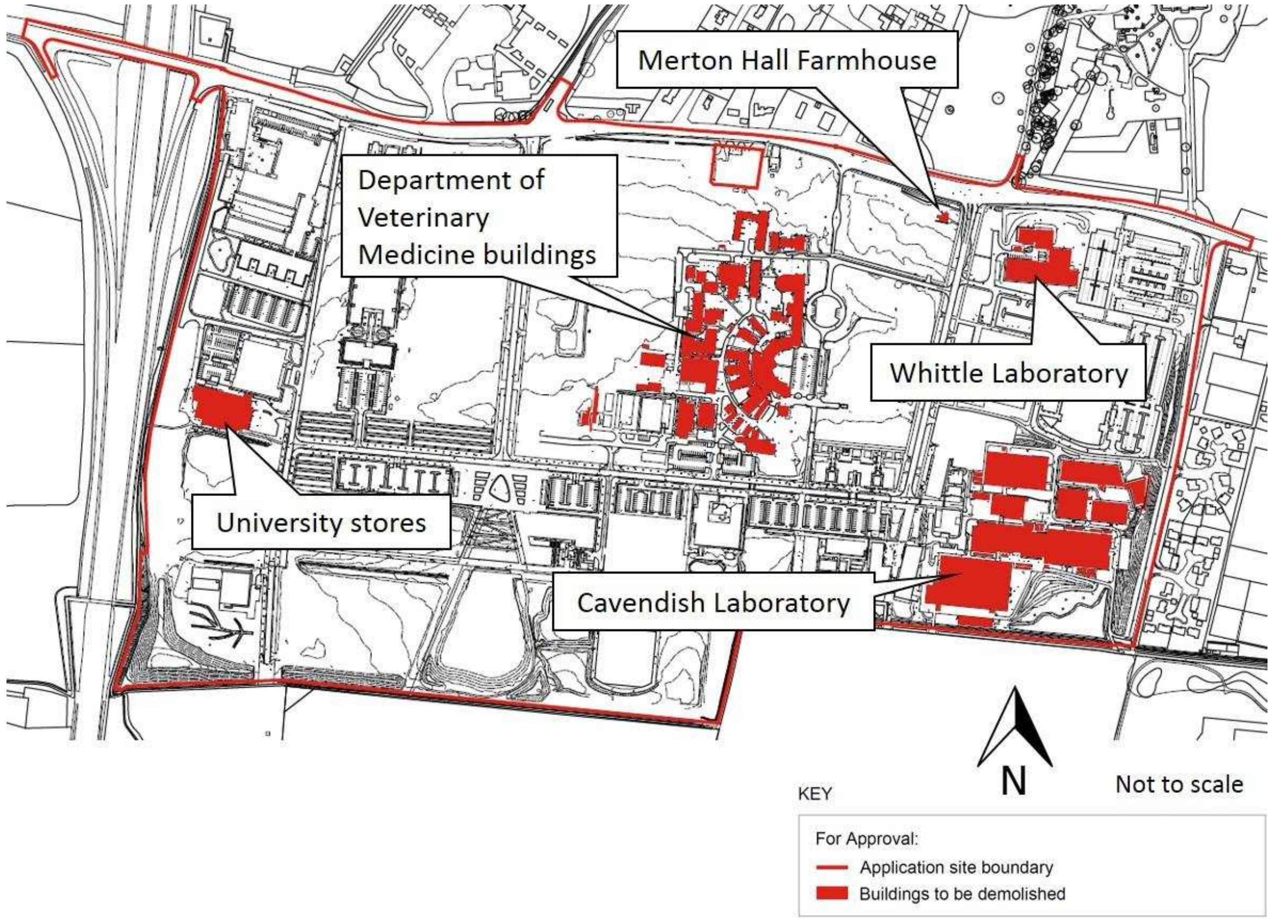

Figure 2.7 Buildings scheduled for demolition

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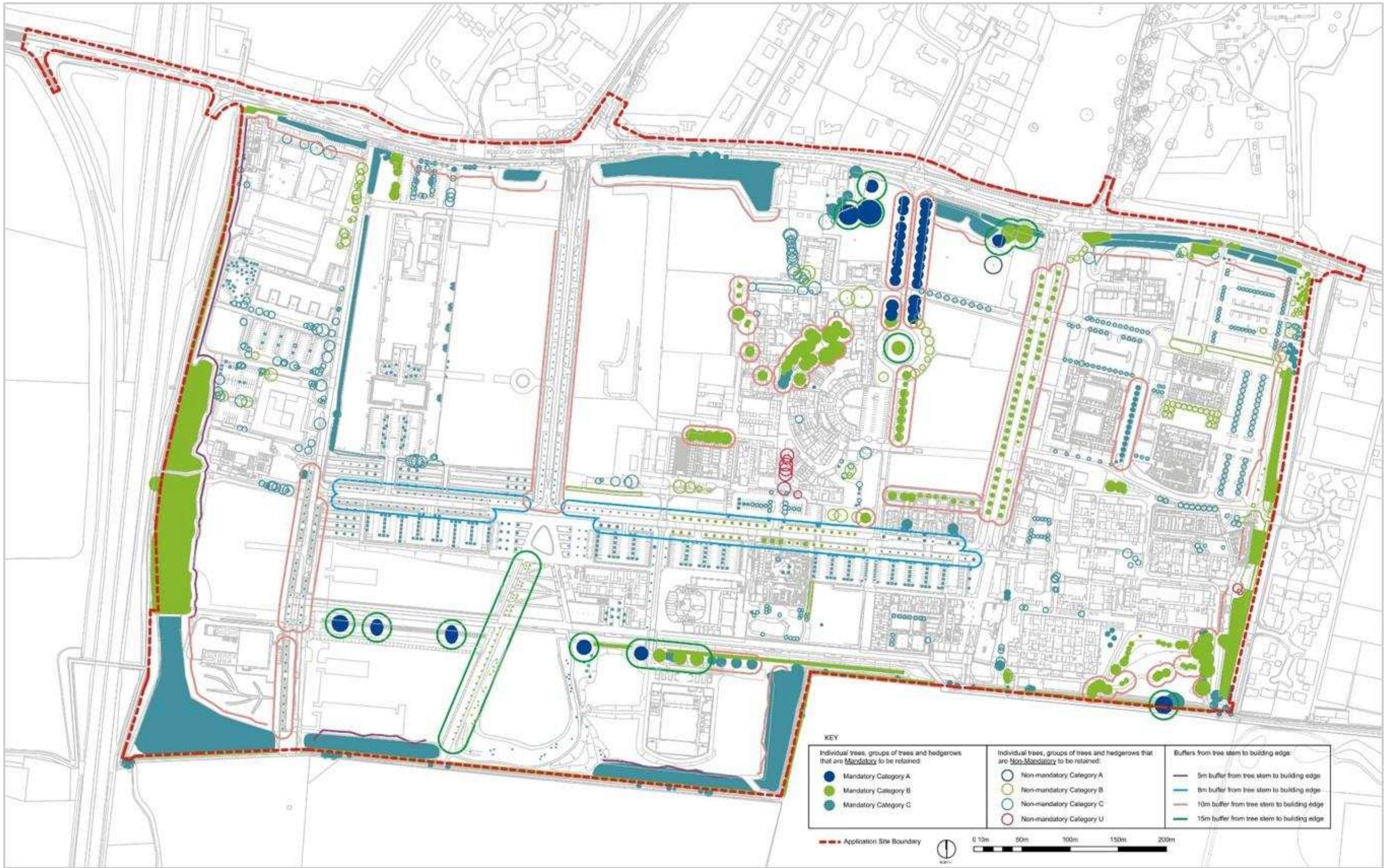

Figure 2.8 Trees to be retained

2.4 Alternatives

2.4.1 The starting point for the Proposed Development is the existing planning permission for the Site which has been partially built out, resulting in the construction of the existing buildings, landscaping and infrastructure, including the internal road network, access points and utilities. In addition there are other buildings under construction which further constrain the Proposed Development.

2.4.2 The evolution of the Proposed Development has resulted in a number of discrete alternatives for certain sections of the Site which have since been evaluated and the preferred option selected. The Proposed Development promotes sustainable intensification, working within the context of significant development and infrastructure already present on the Site.

2.4.3 The EIA has influenced the emerging design and changes to the Proposed Development have been made to avoid or reduce potential significant environmental effects. The alternatives considered include:

- Do-nothing – the existing planning permission is built out. This alternative has been discounted because it fails to achieve the University of Cambridge's vision for the Site;
- Reduced amount of development across the Site – a lower density of development than being proposed. This alternative has been discounted because it would fail to maximise the potential for the Site;
- Retention / demolition of existing buildings – some of the buildings scheduled for demolition to be retained. This alternative has been discounted because it fails to achieve the University of Cambridge's vision for the Site;
- Energy centre location – a different location for the energy centre along the northern boundary. This alternative has been discounted because of higher emissions concentrations at neighbouring properties, and high infrastructure costs;
- Access and movement – additional primary access routes on to Madingley Road. This alternative has been discounted because of the impact to traffic flows along Madingley Road; and
- Building heights – an increase in the heights of the proposed buildings. This alternative has been discounted because of the unacceptably high impact to the landscape.

2.4.4 The initial planning application had a different set of parameter plans which showed higher overall building heights along with a number of taller built elements as shown in Figure 2.9. Following concerns about the impact of the Proposed Development on the landscape, key viewpoints and the setting of listed buildings and conservation areas an alternative height parameter plan has been produced as shown in Figure 2.10. This has eliminated the taller built elements and reduced the overall building heights so as to minimise the impacts on long distance views.

2.4.5 In February 2017, the Schlumberger Gould Research Centre, which is within the Site, was Grade II* listed. Further discussions were held with Historic England and Cambridge City Council and following these a further reduction in the heights of the proposed buildings near the Schlumberger Gould Research Centre was made to protect the setting of the building. In addition the heights of the proposed buildings opposite the Conduit Head Road Conservation Area were also reduced in height to reduce the potential impact on the setting of the Conservation Area. The Proposed Development shown in Figure 2.3 reflects these reduced heights.

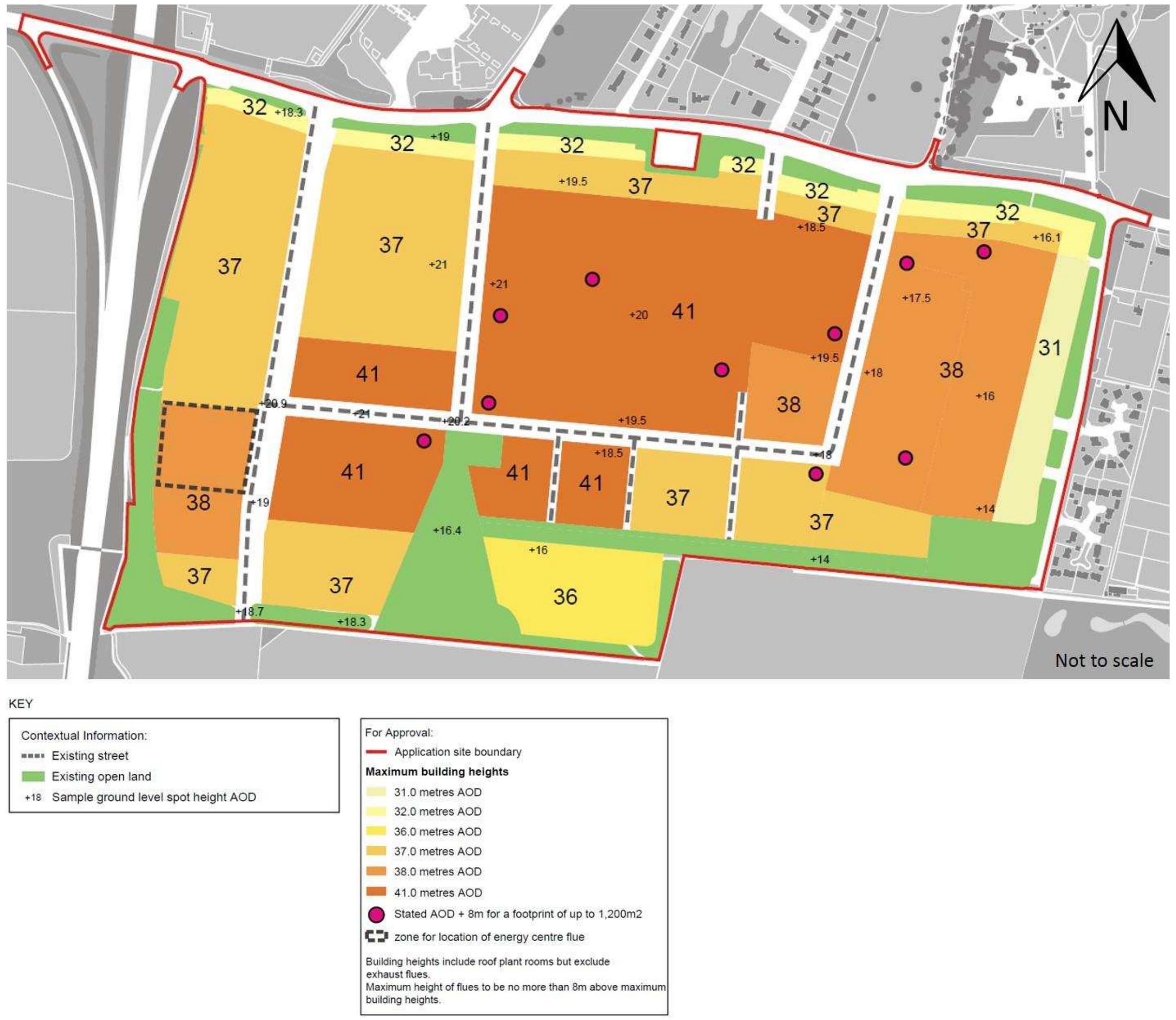

Figure 2.9 Initial planning application height parameter plan

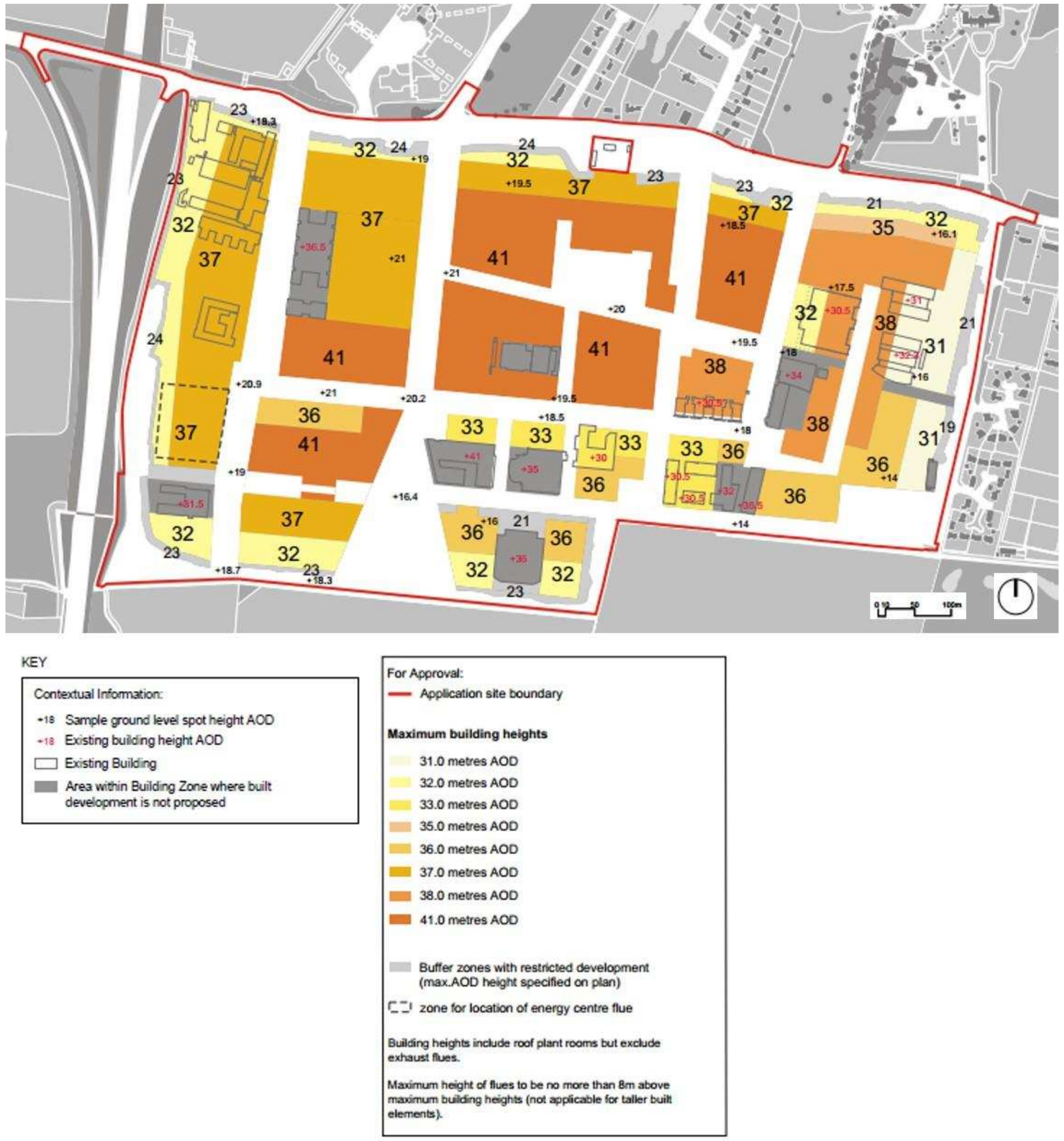

Figure 2.10 Alternative height parameter plan with reduced building heights and removal of the taller built elements.

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3. Significant environmental effects

3.1.1 Cambridge City Council issued the University of Cambridge with a Scoping Opinion which sets out what information needs to be included within the Environmental Statement. The Scoping Opinion provides the basis of the environmental impact assessment by determining which elements of the environment the City Council believe could be significantly impacted by the Proposed Development. In accordance with the Scoping Opinion, detailed analysis has been undertaken to quantify, where possible, the extent of these significant effects.

3.1.2 The approach to the EIA is as follows

1. Define the baseline by identifying key features of the existing environment through a combination of desk studies and field surveys;
2. Evaluate the potential impacts identified in the Scoping Opinion through a combination of qualitative and quantitative analysis;
3. Identify any mitigation measures that may be required to avoid or minimise adverse environmental effects from the Proposed Development; and
4. Report the residual environmental effects after the mitigation measures have been implemented.

3.1.3 A summary of the significant residual environmental effects that could arise during construction and operation of the Proposed Development is shown in Table 3.1.

Table 3.1 Summary of environmental effects

Environmental topic	Existing conditions (baseline)	Potential impacts	Proposed mitigation	Summary of predicted environmental effects
Ecology	The majority of the habitats on the Site are unremarkable comprising mainly amenity grassland, semi-improved grassland, hardstanding and buildings. There are a few areas with greater value which includes an area of scrub and woodland along the western boundary that is designated as a City Wildlife Site (CiWS), a hedgerow along the southern boundary designated as a County Wildlife Site (CWS), a number of drainage ditches and ponds and some veteran trees. There is one confirmed bat roost and bats have been recorded overflying the Site. Smooth newts are likely to be breeding on the Site but no great crested newts were found. An artificial badger sett was previously constructed on Site which appears to be well used. 46 species of birds were recorded on the Site some of which are expected to be nesting within existing vegetation. A colony of house martins and swallows was found nesting in buildings on the Site. A number of invasive plant species were also found.	Impacts during construction of the Proposed Development include the following: • Demolition of buildings with bird nests and a bat roost; • Clearance of vegetation; • Leaks and spills which could migrate to surface water bodies; • Re-profiling of surface water bodies; • Disturbance caused by noise and lighting; and • Potential for the spread of invasive plant species. Impacts during the operation of the Proposed Development include the following: • Increase in the amount of lighting on Site; and • Reduction in the amount of foraging and commuting habitat for bats	Proposed mitigation measures include: • Implementation of the Construction Environment Management Plan (CEMP) to avoid the potential for leaks and spills; • Establishing a fenced off protective buffer around sensitive habitats and areas; • Replacement of aquatic planting with planting of an equivalent or better habitat value; • Re-profiled water bodies will be designed to maximise ecological benefit; • The use of bird and bat boxes to replace nests and roosts that will be lost; • Careful specification and design of new lighting and removal of some existing lighting; • Removal of invasive plant species prior to construction; • Establishment and enhancement of green corridors through the Site; and • Retention / protection of existing trees.	The loss of habitats from the Site will not be significant as they are of low ecological value and the maintenance and enhancement of green corridors through the Site will ensure that commuting linkages to foraging sites are maintained. Specific mitigation measures for protected species will be implemented under licence and will ensure that significant adverse effects do not arise. There will be no significant adverse or beneficial effects to ecological receptors during construction or operation of the Proposed Development.

Environmental topic	Existing conditions (baseline)	Potential impacts	Proposed mitigation	Summary of predicted environmental effects
Historic environment	The historic environment comprises buried archaeological assets and above ground built heritage assets. An archaeological investigation on the Site was undertaken where three archaeological sites were unearthed dating from the Iron to Roman Ages. In addition previous investigations on the Site have unearthed Roman settlements. With the exception of the recently grade II* listed Schlumberger Gould Research Centre, none of the remaining buildings on Site are listed or locally listed but notable buildings include the Merton Hall Farmhouse, which dates from the mid to late 19^{th} century. The Site is situated in close proximity to a number of listed buildings and conservation areas including Conduit Head Road Conservation Area, West Cambridge Conservation Area, three grade II* listed buildings, fifteen grade II listed buildings, and a grade II registered park and garden, all of which are located within 500m of the Site.	A number of construction activities including piling and excavations for foundations, services, and earthworks could result in the disturbance or loss of the archaeological sites. Construction works will impact the setting of the conservation areas adjacent to the Site and some of the associated listed buildings. During construction Merton Hall Farmhouse will be demolished. During operation, the increased density and proximity of contemporary buildings will impact the setting of the adjacent conservation areas and some of the associated listed buildings including the recently listed grade II* Schlumberger Gould Research Centre.	Further archaeological field investigations will be undertaken in areas where disturbance to the ground due to piling and excavation will occur. The Design Guidelines for the Proposed Development specify a sympathetic approach to the facades of buildings facing outwards towards listed buildings and conservation areas. Boundary planting in these areas will also be strengthened. The Design Guidelines secure a key view corridor through the Site towards the Schlumberger Gould Research Centre and provide additional protection to the setting of the building.	The archaeological assets are not of sufficiently high value to require preservation in-situ and they will be fully recorded through further field investigations prior to construction. The loss of these assets will not be significant. The demolition of Merton Hall Farmhouse would not be a significant effect due to its low historic value. The densification of the Site with contemporary institutional buildings particularly in the north east corner of the Site will result in an adverse effect to the setting of the Schlumberger Gould Research Centre on the Site and to the setting of a grade II listed building and the Conduit Head Road Conservation Area adjacent to the Site, during both construction and operation.
Landscape and visual	The Site is located on the western fringes of the city adjacent to the green belt and open countryside. A total of nine distinct local landscape character areas have been identified that could be affected by the Proposed Development. 23 key viewpoints have been identified and appraised.	During construction, works activities and the presence of tall cranes and construction plant will be new additions to the landscape which will be out of keeping and could impact both the character of the surrounding area and views from the key viewpoints.	The Design Guidelines include measures to minimise the impact of denser development on the Site. This includes controls on the maximum lengths of building facades, minimum gaps between buildings and new planting to soften the urban edges and provide screening.	During construction, one landscape character area around the village of Coton will be significantly adversely affected along with six viewpoints with clear views across the Site. This includes views from properties at The Lawns and Perry Court off Clerk Maxwell Road. Once construction is complete the Proposed Development will result in a westward urban encroachment, impacting on four landscape character areas, to the south and west of the Site, and 12 viewpoints. Over time screening vegetation will mature which will soften the development reducing the overall impact. Significant effects will still occur to the same four landscape character areas but only seven of the 12 viewpoints will be impacted.
Socio-economics	Both the City of Cambridge and South Cambridgeshire are prosperous areas, although Cambridge in particular has areas of notable deprivation, such as King's Hedges. Professional, scientific & technical enterprises' formed the single largest category of businesses both in Cambridge and South Cambridgeshire (22.8% and 21.7%, respectively, of all businesses) in 2014. Cambridge and South Cambridgeshire have limited land availability for both residential and commercial uses - a supply constraint which, in combination with high demand, has resulted in high rental costs. There is intense pressure on B1a (office) use class floorspace. Reflecting its status as a major student city, Cambridge has a younger than average population profile.	Construction works will increase the supply of jobs in the construction sector including skilled and unskilled trades. The supply of indirect jobs will also increase due to supply chain demands and income multiplier effects. Sourcing of construction materials and plant from local suppliers will result in local economic growth. There will be some disruption to local businesses and communities during construction due to noise, dust and construction traffic. During operation there will be an increase in job provision to about 14,000 including those already present on Site.	The CEMP will specify measures to minimise disruption from noise, dust and construction traffic	During construction there will be some temporary disturbance to local businesses and communities but mitigation will ensure this does not result in significant effects. The increase in job provision during construction and operation and the associated multiplier effects will result in local regional economic growth that will be a significant benefit of the Proposed Development. Significant beneficial socio-economic effects will occur during both the construction and operation of the Proposed Development.

Environmental topic	Existing conditions (baseline)	Potential impacts	Proposed mitigation	Summary of predicted environmental effects
Traffic and transport	Much of the road network within Cambridge is operating at close to capacity during the morning and evening rush hours which results in environmental issues relating to severance, driver delay, pedestrian and cyclist delay, reductions in pedestrian and cyclist amenity, and intimidation of pedestrians and cyclists. The high traffic flows mean that drivers will experience delays when travelling during the peak hours. Delays for pedestrian and cyclists are not as badly affected due to signalised crossings and traffic islands along the worst affect routes. Pedestrian and cyclist amenity is generally good due to the provision of designated cycle and pedestrian routes of a good quality away from busy roads. This also applies to pedestrian and cyclist intimidation levels although where pedestrians and cyclists travel along busy roads, such as Madingley Road, intimidation levels increase.	Construction works will require additional vehicles to travel to the West Cambridge site to deliver construction workers, construction materials, and construction plant and equipment. This will result in a small increase in the overall traffic flows but a significant increase in the proportion of heavy vehicles particularly along the short stretch of the Madingley Road between the Site and Junction 13 of the M11 motorway. Once the Proposed Development is open there will be an increase in traffic mainly due to workers at the Site travelling to and from their place of work.	Delivery routes during construction will be agreed with the Local highway Authority so that heavy vehicles avoid Cambridge City centre altogether and will principally travel to and from the Site along Madingley Road from junction 13 of the M11 motorway. Once the Proposed Development is open, a Framework Travel Plan will be implemented encouraging the use of public transport, cycling and walking as the principal means of travelling to and from the Site. There is still anticipated to be an increase in traffic travelling to and from the Site and this will be carefully monitored and additional mitigation measures implemented if and when necessary.	Construction traffic is not expected to result in any significant adverse effects as the delivery routes will direct construction traffic away from sensitive areas within the city. Once the Proposed Development is fully open there will be an increase in traffic travelling along Madingley Road but this will not result in any significant adverse effects.
Air quality	There is an Air Quality Management Area (AQMA) within Cambridge encompassing the area within the inner ring road. The AQMA is located approximately 800m to the east of the West Cambridge site and has been declared due to the high level of nitrogen dioxide which exceeds national air quality objectives. This pollutant is closely associated with traffic emissions and the high levels are due to traffic within the city.	During construction, works activities such as the handling and storage of aggregates, excavation, and demolition of existing structures could give rise to excessive levels of dust which can cause nuisance to nearby residents and damage habitats and designated ecological sites. Once the Proposed Development is open there will be emissions from the increase in traffic travelling to and from the Site, and emissions from the energy centre.	A range of best practice methods of working will be employed during construction to minimise the risk of generating dust. Traffic emissions during operation will be minimised through the implementation of the Framework Travel Plan which sets out how traffic travelling to and from the Site will be minimised. Emissions from the energy centre will disperse naturally without the need for any abatement measures.	Good management during construction will ensure that nuisance to residents and impacts to ecological receptors from dust will not be significant. The increase in traffic emissions, and emissions from the energy centre are not predicted to result in any exceedences of national air quality objectives at any residents or designated ecological sites. There will be no significant adverse or beneficial effects during construction or operation of the Proposed Development.
Noise and vibration	The principal source of noise in the area is traffic with levels varying considerably depending on the proximity to main roads including the M11 motorway and Madingley Road.	Certain construction activities are likely to be noisy in nature such as demolition and piling. Some construction activities could also cause ground borne vibration. Once the Proposed Development is fully open, noise is likely to be generated by traffic travelling to and from the Site, the energy centre and plant associated with individual buildings.	A range of best practice methods will be employed to minimise levels of construction noise and vibration. Implementation of the Framework Travel Plan will minimise traffic noise caused by the Proposed Development by encouraging the use of public transport, cycling and walking. Noise from building plant and the energy centre can be minimised through the specification of the type of plant, location and orientation, and the design of the buildings housing the plant.	The details of construction activities have still to be determined but based on the assumptions used to inform the assessments it is unlikely that noise and vibration effects during construction could result in nuisance to nearby residents. Once the Proposed Development is fully open receptors on the Site could be significantly affected by noise from the building plant and the energy centre. This will depend on the detailed design of new buildings and the energy centre and could be effectively mitigated. No receptors off the Site will be affected.

Environmental topic	Existing conditions (baseline)	Potential impacts	Proposed mitigation	Summary of predicted environmental effects
Water environment	The upper reaches of the Coton Brook are entirely located within the Site with surface water drainage from the Site providing the source for the water course. The Coton Brook drains to Bin Brook which is a tributary of the River Cam. The watercourse is heavily modified in places and water quality varies accordingly. The northern part of the Site drains northwards and discharges to Washpit Brook which is located off the Site. There is a low risk of flooding at the Site from rivers. The majority of the Site has a low risk of surface water flooding, but this is an issue in some localised areas on the Site.	During construction there is a risk that surface water runoff could become contaminated from sediment, chemicals and fuels used for construction and stored on Site. This could impact the water quality of Coton Brook and Washpit Brook and the associated downstream surface water courses. Works to modify the profile of the upper reaches of the Coton Brook to provide more surface water storage could also impact water quality downstream. During operation there will be an increase in hard standing which could result in an increase in the volume of surface water running off the Site causing flooding downstream.	The implementation of best practice construction measures and the implementation of guidelines published by the Environment Agency will minimise the risk of polluting surface water courses during construction. The Site wide drainage strategy includes Sustainable Urban Drainage (SUDS) principals and other measures to capture surface water runoff and release it at greenfield runoff rates.	Good management of the construction site and activities will minimise the risk of polluting surface water courses. The surface water discharge rates will be similar to the existing discharge rates so that the risk of flooding to areas downstream of the Site will not change. There will be no significant adverse or beneficial effects to the water environment during construction or operation of the Proposed Development.
Ground conditions	The Site has historically been used for agriculture. Development began in the 1940s with the construction of an aircraft repair facility. After WWII these buildings were vacated and the Site was used by the University of Cambridge when the Department for Veterinary Medicine buildings were constructed. Subsequent development has culminated in the partial completion of the existing masterplan. The historic use of the Site raises the possibility of contamination with sources including storage and disposal areas for the laboratories, as the Environment Agency hold records for minor pollution incidents relating to the laboratories. None of these have resulted in any significant effect.	Site workers could encounter localised areas of contamination during excavation, piling or any earthworks activities. Leaks and spills of chemicals and fuels from construction equipment, plant and storage areas could lead to localised contamination of soils. Leaks and spills of chemicals from laboratory storage and disposal areas could result in localised contamination of soils. The creation of new pathways to ground water through drilling deep boreholes for ground source heat pumps.	Construction workers that are at risk of coming into contact with contaminated materials will wear personal protective clothing. The use of good construction practices as set out in Environment Agency and CIRIA guidance will minimise the risk of leaks and spills during construction, and minimise any impacts to ground water. Chemical storage and disposal areas during operation will be designed to the highest standards and will include appropriate bunding and drainage to prevent any escape of chemical spills and leaks.	The risk of construction workers encountering contamination on the Site during construction is low and the use of personal protective equipment will minimise any effects should contamination be encountered. Good construction practice and design will minimise the risk of contamination from leaks and spills during both construction and operation. There will be no significant adverse or beneficial effects during construction or operation of the Proposed Development.
Cumulative effects	Five major developments within the north west Cambridge area are predicted to be constructed at the same time as the Proposed Development: • North West Cambridge; • National Institute of Agricultural Botany (NIAB); • Orchard Park; • Northstowe; and • West Cambourne	There is a risk that multiple impacts from the Proposed Development identified in the ES to the same receptor could result in significant in-combination effects to the receptor during both construction and operation. The cumulative effect of the construction and operation of the Proposed Development and the five other major developments could result in effects of greater magnitude than predicted for any of the developments individually.	Additional mitigation measures may be required during construction to minimise in-combination effects. This will be determined when full details of the proposed construction works are known.	The cumulative effects of the Proposed Development in conjunction with the five other major developments in north west Cambridge will give rise to significant adverse landscape effects, during both construction and operation, due to the urban expansion that will result. There will be significant beneficial cumulative socio-economic effects in the city and region during the construction phase and once the Proposed Development is fully open. This is due to the combined increase in employment land, housing, services, and the contribution that the six developments make to local, regional and national socio-economic policies

3.1.4 The Proposed Development has been carefully designed to ensure that significant environmental effects are minimised, as far as possible, whilst enabling the University of Cambridge to deliver its vision for the Site and bring about the significant socio-economic benefits that will result. Nevertheless there will be significant adverse environmental effects during construction and operation relating to built heritage, the landscape and views, noise and vibration, and traffic and transport. There will also be significant cumulative effects relating to the landscape when considered with other planned developments in the north west of Cambridge.

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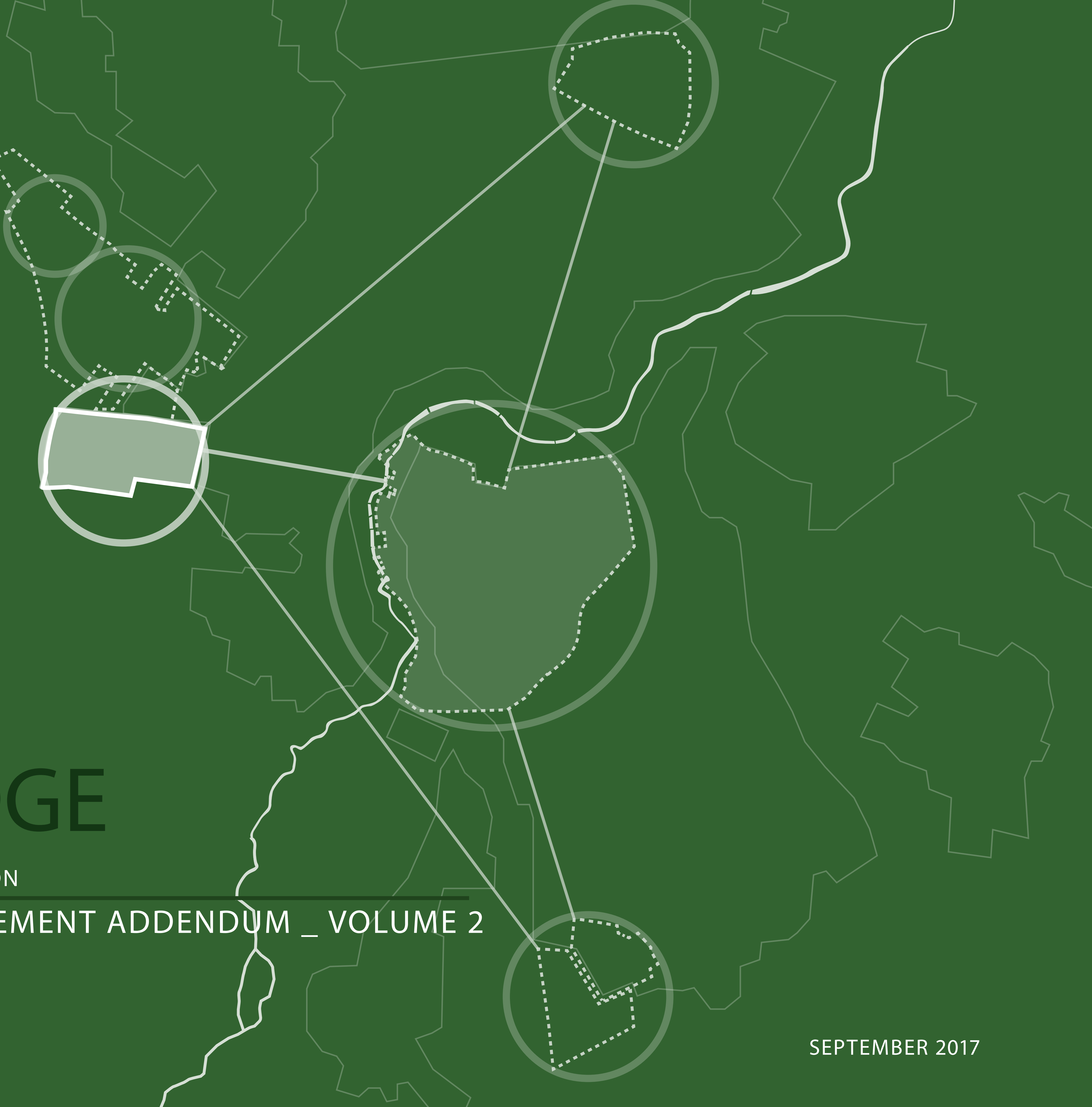

WEST CAMBRIDGE

OUTLINE PLANNING APPLICATION

ENVIRONMENTAL STATEMENT ADDENDUM _ VOLUME 2

MAIN REPORT

UNIVERSITY OF CAMBRIDGE

SEPTEMBER 2017

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Document history

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Rev 1.0	Draft	Multiple	DP	PW	PW	12/07/17
Rev 2.0	Draft	Multiple	DP	PW	PW	15/08/17
Rev 3.0	Final	Multiple	DP	PW	PW	06/09/17

EIA Quality Mark

This Environmental Statement and the Environmental Impact Assessment (EIA) carried out to identify the significant environmental effects of the proposed development have been undertaken in line with our commitments as members of the EIA Quality Mark.

The EIA Quality Mark is a voluntary scheme operated by the Institute of Environmental Management and Assessment (IEMA) through our EIA activities are independently reviewed, on an annual basis, to ensure we continue to deliver excellence in the following areas:

EIA Management
EIA Team Capabilities
EIA Regulatory Compliance
EIA Context & Influence
EIA Content
EIA Presentation
Improving EIA practice

To find out more about the EIA Quality Mark and our registration to it please visit: www.iema.net/qmark

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1. Introduction

1.1 Background

1.1.1 The University of Cambridge (the applicant) submitted an outline planning application (planning reference 16/1134/OUT) for a new masterplan (referred to as the Proposed Development within this document) at the West Cambridge Site (referred to as the Site within this document) on the 16th June 2016. A full description of the planning application is shown in the box below. By virtue of its size and scale, the Proposed Development was classified as Environmental Impact Assessment (EIA) Development, under the Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (as amended 2014), and accordingly an Environmental Statement (ES) was submitted with the outline planning application.

> Outline planning permission with all matters reserved is sought for up to 383,300m² of development comprising up to 370,000m² of academic floorspace (Class D1 space), commercial/research institute floorspace (Class B1b and sui generis research uses), of which not more than 170,000m² will be commercial floorspace (Class B1b); up to 2,500m² nursery floorspace (Class D1); up to 1000m² of retail/food and drink floorspace (Classes A1-A5); up to 4,100m² and not less than 3,000m² for assembly and leisure floorspace (Class D2); up to 5,700m² of sui generis uses, including Energy Centre and Data Centre; associated infrastructure including roads (including adaptations to highway junctions on Madingley Road), pedestrian, cycle and vehicle routes, parking, drainage, open spaces, landscaping and earthworks; and demolition of existing buildings and breaking up of hardstanding.

1.1.2 During the consultation process on the planning application several concerns were raised about the potential landscape and visual effects and effects on the setting of built heritage assets. Taking these considerations into account the applicant has revised the Proposed Development, to reduce potential adverse effects, and has re-submitted the planning application.

1.2 Changes to the Proposed Development

1.2.1 The outline planning application defined the Proposed Development in two principal documents namely:

1. Parameter plans, and
2. Design guidelines.

1.2.2 The parameter plans define the basic principles of the Proposed Development including the proposed land use classification, quantum of development, maximum extent of the building envelope, minimum extents of public open space and landscaping, and access routes through the Site. The parameter plans submitted in the outline planning application were kept as simple as possible to define clearly what was being applied for. Consultation feedback commented that this made it difficult to read the parameter plans in conjunction with each other. The amended parameter plans now include areas of overlap to address these concerns so, for example, where minimum landscape requirements limit the extents of the building zones, this is now reflected in the building zone parameter plan.

1.2.3 To address the concerns over the potential effects to the landscape and visual receptors and the historic environment, the maximum heights of buildings, shown in the building heights parameter plan, have been reduced and the taller built elements have been removed. Particular attention has been directed to the heights of the building zones immediately surrounding the Schlumberger Gould Research Centre which has received a Grade II* listing since the previous planning application submission. Further refinements to the building heights have also been made through setbacks at the roof level and the building zones have been reduced to provide for more space at the site boundaries to allow the woodland buffers to grow to their full potential.

1.2.4 The Design Guidelines provide a framework of design principles that must be adhered to when undertaking detailed design. The Design Guidelines specify several measures which can be regarded as 'in built' environmental mitigation measures such as controls to building design to minimise the bulk and impact to the wider landscape, specifications for new planting and identification of existing planting that must be retained to soften the build development, and other measures to minimise the impact to the historic environment and maximise biodiversity on Site. The measures which are considered to be 'in built' mitigation are listed in Chapter 2.

1.2.5 The descriptions of the Proposed Development and the proposed quantum of development have not been amended and remain the same as the submitted outline planning application.

1.3 Implications for the Environmental Statement

1.3.1 The ES submitted with the outline planning application considered a worst case scenario where new buildings could potentially be built up to the maximum extents shown in the parameter plans. As the parameter plans have amended these extents, to lessen the potential adverse effects, the submitted ES now overestimates the extent of the potential effects from the revised parameter plans. The environmental assessments which are affected by the amendments to the Proposed Development are historic environment, landscape and visual effects, traffic and transport, air quality, noise and vibration, water environment, and ground conditions. These assessments have been amended to reflect the revised Proposed Development.

1.4 Purpose of this document

1.4.1 This document is an Addendum to the submitted ES, Volume 2, Main Report. The purpose of this document is to update the relevant chapters and sections of the submitted ES to reflect the changes to the Proposed Development. Table 1.1 shows the sections of the submitted ES which are supplemented by the content of this document.

Table 1.1 Sections of text in the submitted ES superseded by this document

ES addendum (this document) sections	Submitted ES sections
Chapter 2 Proposed Development	Chapter 3 Proposed Development
Chapter 4 Alternatives	Chapter 4 Alternatives
Chapter 7 Historic environment	Chapter 7 Historic environment – following sections only • 7.5 Impact assessment • 7.6 Mitigation measures • 7.7 Summary

ES addendum (this document) sections	Submitted ES sections
Chapter 8 Landscape and visual	Chapter 8 Landscape and visual – following sections only • 8.5 Impact assessment – Operational phase only. Construction phase effects remain unchanged • 8.6 Mitigation measures • 8.7 Summary
Chapter 10 Traffic and transport	Chapter 10 Traffic and transport
Chapter 11 Air quality	Chapter 11 Air quality – following sections only • 11.5 Impact assessment – Operational phase only. Construction phase effects remain unchanged • 11.7 Summary
Chapter 12 Noise and vibration	Chapter 12 Noise and vibration – following sections only • 12.5 Impact assessment – Operational phase only. Construction phase effects remain unchanged • 12.7 Summary
Chapter 13 Water environment	Chapter 13 Water environment – following sections only: • 13.6 Mitigation measures – operation only
Chapter 14 Ground conditions	Chapter 14 Ground conditions – following sections only • 14.5 Impact assessment • 14.6 Mitigation measures – construction phase only • 14.7 Summary
Chapter 15 Cumulative effects	Chapter 15 Cumulative effects – following sections only • 15.5 Impact assessment – Cumulative effects – Operational phase only • 15.7 Summary
Chapter 16 Schedule of mitigation	Chapter 16 Schedule of mitigation – Table 16.1 following rows only: • Historic environment • Landscape and visual • Traffic and transport • Ground conditions

1.4.2 Separate addenda have also been produced for ES Volume 1 Non-technical Summary and ES Volume 3 Appendices.

3. The Proposed Development

3.1 The vision

3.1.1 The University of Cambridge aspires to develop the Site into a high quality academic and research campus. The existing masterplan has led to individual plots being developed that do not provide the cohesive character required to optimise the Site or make it an attractive integrated part of the city.

3.1.2 The University of Cambridge has a vision for the Site that aspires to provide a high quality urban environment that is well integrated to the city centre and surrounding suburbs, as well as emerging developments such as the north west Cambridge development. The vision comprises five themes which collectively provide the purpose of the Proposed Development:

1. Optimise the amount of development on Site, supporting the city and region as a world leader in research and development.
2. Support the commercialisation of knowledge through entrepreneurship and collaboration with industry.
3. Create and sustain a high quality place by transforming the physical and social environment for Site users and neighbours across the city.
4. Deliver adaptable and efficient space to support viability and long term value creation.
5. Deliver sustainable development, proactively investing in the quality of place and integration within the city.

3.2 Role of the different documents

3.2.1 The Proposed Development is defined principally by the two separate documents listed below, both of which have been submitted for approval as part of the planning application:

- Parameter plans
- Design guidelines

3.2.2 The parameter plans define the main principles of the Proposed Development and set the maximum and minimum extents for the different development parameters. The design guidelines define the style and form of the Proposed Development and specify detailed design measures that must be incorporated into the reserved matters applications to, amongst other things, ensure the specified environmental mitigation is incorporated into the design.

3.3 Parameter plans

3.3.1 The Proposed Development will support the delivery of the vision through a series of parameter plans, design guidelines and a broadly defined description. This will allow flexibility in the description of the development. This reflects a key aim of the Proposed Development, to build flexibility into the planning permission, so that the University can respond to changes in academic and commercial demand over the next twenty years or so, without needing to amend the outline planning permission or seek a fresh permission.

3.3.2 The parameters for the Proposed Development are described through five parameter plans and their accompanying statements. The plans are:

- Land use;
- Development zones;
- Building heights;
- Access and movement; and
- Open space and landscape.

Land use

3.3.3 Built development would comprise the three land use areas shown in Figure 3.1. The Proposed Development includes the existing land uses on the Site and does not seek to introduce new land uses. It does seek to amend the extent to which permitted land uses are present on the Site. The largest land use area comprises a mix of academic and commercial uses and includes the existing British Antarctic Survey, Schlumberger and Aveva plots as well as the existing Computer Laboratory, Roger Needham Building, CAPE Building and the Physics of Medicine and Maxwell Centre, all of which would be retained.

3.3.4 The mixed use zone comprises planning use classes A1-A5 (shops, financial and professional services, restaurants and cafes, drinking establishments, and hot food takeaways), B1b (commercial research / research institutes) and D1 (non-residential institutions). The mixed use zone includes the South Residences, North Residences and nursery, Hauser Forum and Broers Building, Institute for Manufacturing, Chemical Engineering / Biotech Building, Materials Science and Metallurgy Building and the Innes Building, all of which will be retained.

3.3.5 The smallest zone is for community uses and comprises land use planning classes D1 (non-residential institutions) and D2 (assembly and leisure). This zone includes the existing sports centre which will be retained.

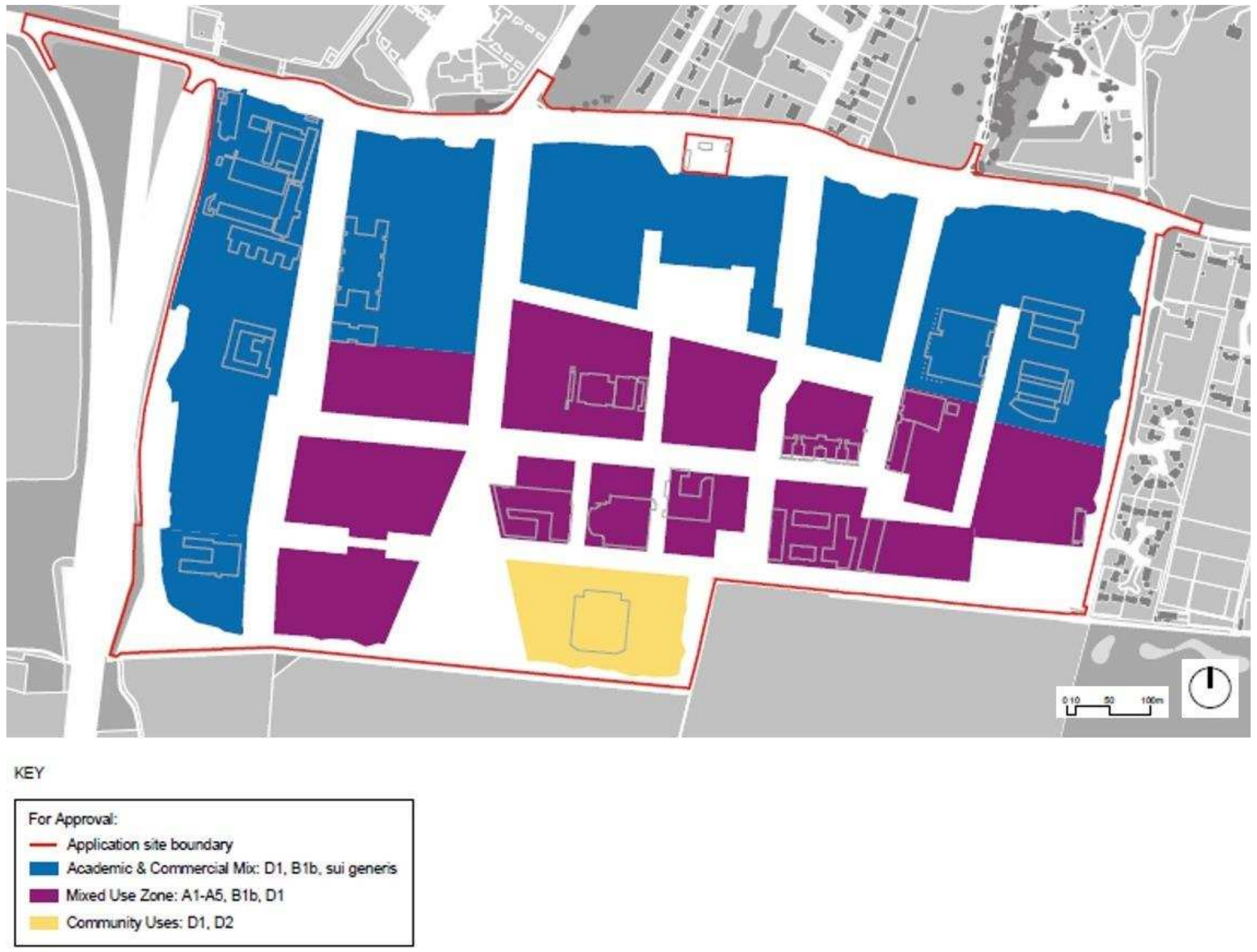


Figure 3.1 Proposed land use

Buildings

3.3.6 Maximum building heights are shown on Figure 3.2. The general building height across the Site will be four storeys for academic / commercial use. Building plant must be included within the height parameters set out on the plan but exhaust flues may extend above these heights.

3.3.7 The Proposed Development comprises four development zones as shown on Figure 3.3. Each development zone is made up of building zones which are the areas of the Site within which buildings can be located. The building zones exclude existing roads and open spaces which would be retained as part of the Proposed Development and proposed safeguarded access routes and open spaces. Table 3.1 shows the maximum developable floor spaces for each development zone and use class.

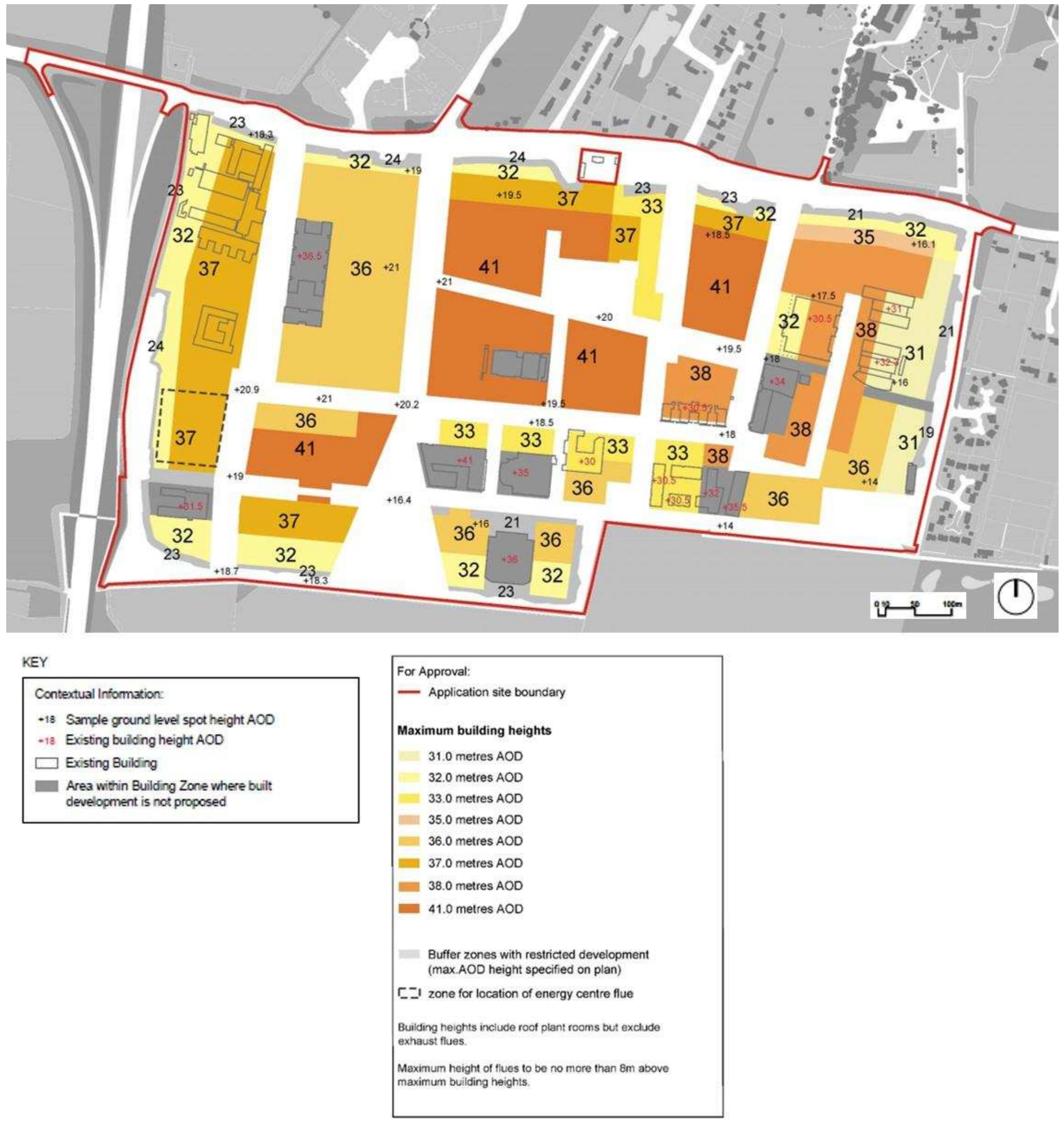


Figure 3.2 Maximum proposed building heights

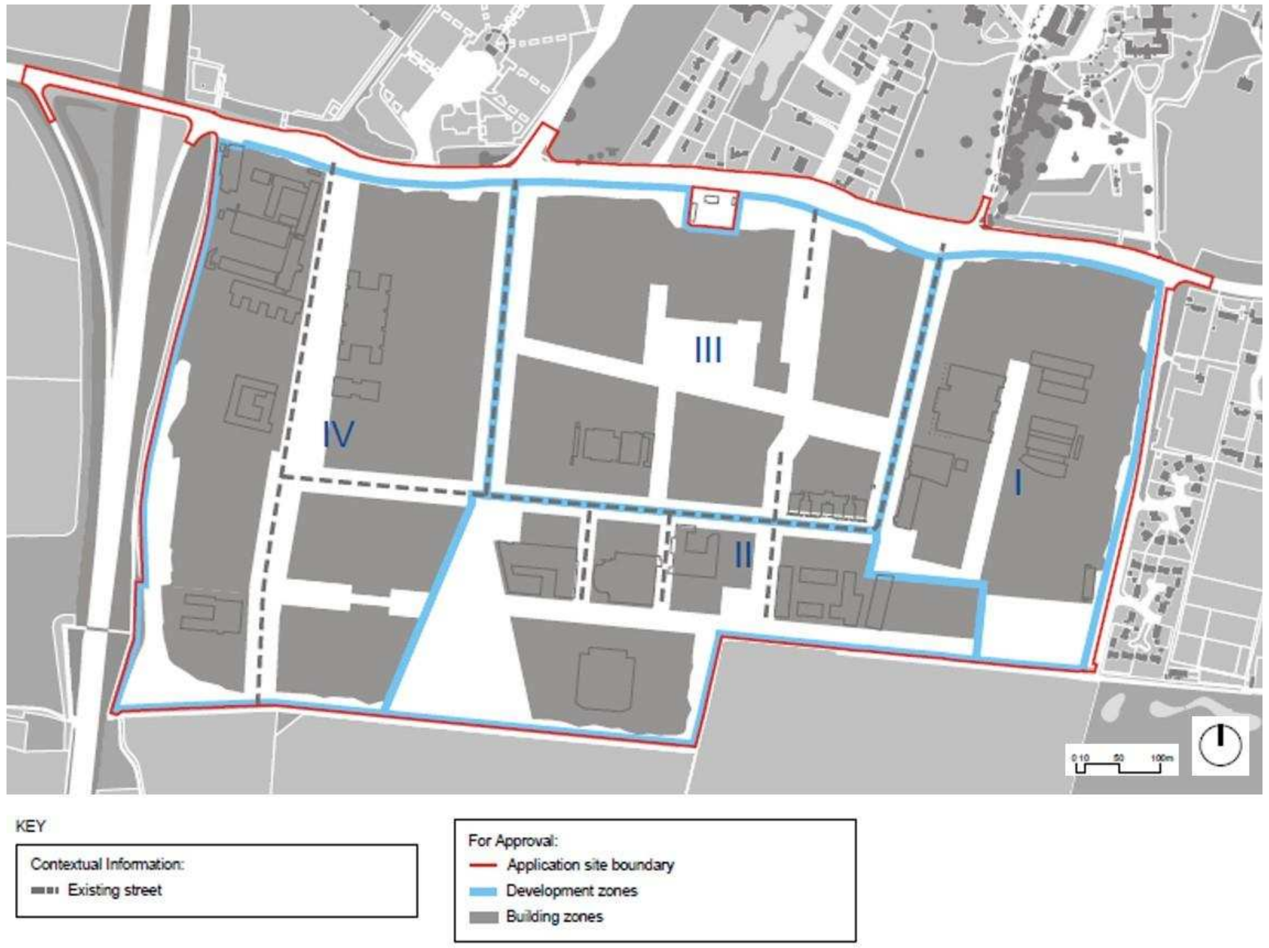


Figure 3.3 Development zones

Table 3.1 Maximum floorspace (m^2) for each use class and development zone

Land use	Academic research	Nursery	Commercial research / research institutes	Shop, café, restaurant, public house	Assembly & leisure (sports)	Ancillary infrastructure (data centre, energy centre)	Total proposed floor space
Use Class	D1	D1	B1b / sui generis	A1 – A5	D2	Sui generis	
Building Zone I	Up to 77,000	Up to 1,500	Up to 21,900	Up to 500	0	0	Up to 77,000
Building Zone II	Up to 38,600	Up to 1,500	Up to 38,600	Up to 300	Up to 4,100	0	Up to 44,500
Building Zone III	Up to 178,400	Up to 1,500	Up to 51,700	Up to 200	0	Up to 2,000	Up to 182,100
Building Zone IV	Up to 104,000	Up to 1,500	Up to 104,000	Up to 500	0	Up to 4,500	Up to 110,500
Total proposed floorspace	Up to 370,000	Up to 2,500	Up to170,000	Up to 1,000	Up to 4,100	Up to 5,700	Up to 383,300

All figures quoted are Gross Floor Area, m^2

Access and movement

3.3.8 The access and movement strategy is summarised in Figure 3.4. Access to the main Site would be from the north off Madingley Road and to a 540 space multi storey car park from the northern end of Clerk Maxwell Road . The four main roads on Site (JJ Thompson Avenue, Charles Babbage Road, High Cross, and Western Access Road / Ada Lovelace Road) would all be retained and used as the principal means for vehicular access to and across the Site. Additional secondary roads would be constructed to increase vehicular connectivity across the Site. All existing and new vehicle routes and accesses would also allow for pedestrian and cycle movements.

3.3.9 A new pedestrian and cycle access point will be created off Madingley Road. The existing pedestrian and cycle access points along Clerk Maxwell Road will be maintained and will be the main arrival points for cyclists and pedestrians travelling from the city centre. The primary pedestrian and cycle routes through the Site include the existing pedestrian and cycle path running adjacent to the southern boundary (Coton footpath). This would be extended to continue across the Site to the western boundary. A second east-west pedestrian and cycle route would access the Site from the existing entrance approximately half way along Clerk Maxwell Road, continuing westwards across JJ Thompson Avenue and through a new open space corridor linking up with High Cross. A north-south route would extend from the West Forum and along High Cross where the route would continue northwards towards the north west Cambridge development. Additional secondary pedestrian and cycle routes would increase connectivity through the Site.

3.3.10 The flexible zones shown in Figure 3.4 illustrate where the proposed routes could go. They provide flexibility in detailed design for landscape and building setbacks which are not currently known but will dictate the precise location of the proposed routes. The flexible zones are not intended to suggest that the routes will not be provided as they are a committed element of the Proposed Development.

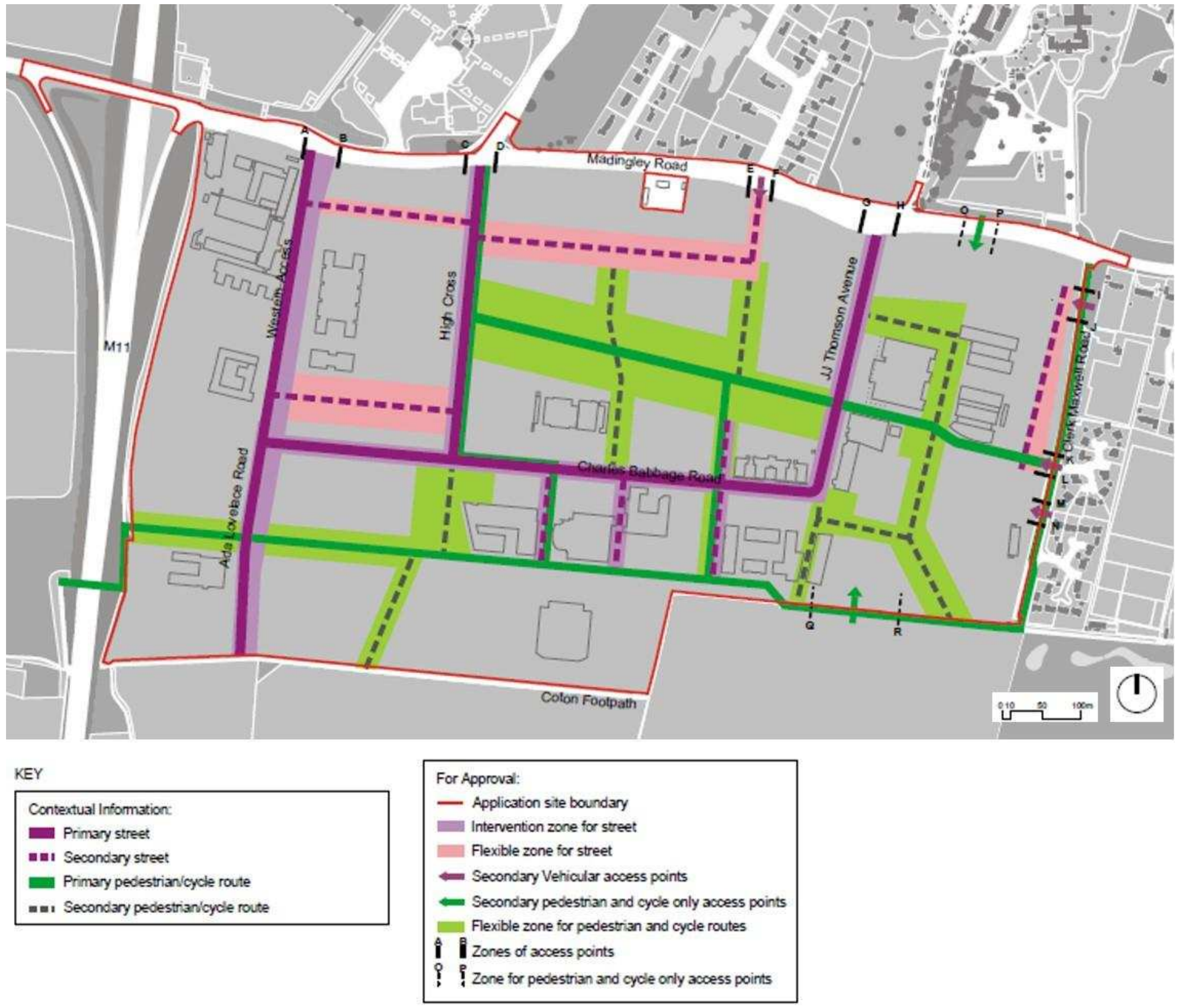


Figure 3.4 Access and movement strategy

Open space and landscape

3.3.11 A series of open spaces and corridors will cross the Site as shown in Figure 3.5. The open space network will provide a variety of uses including informal recreation and outdoor entertainment, landscaping, surface water drainage, nature conservation, and pedestrian and cycle routes.

3.3.12 Detailed design of the open space areas will be agreed through the submission of reserved matters applications pursuant to the outline planning application.

3.3.13 The flexible zones shown in Figure 3.5 illustrate where the proposed landscaping could go on the Site. They provide flexibility in detailed design for building setbacks and plot locations which are not currently known but will dictate the precise location of the landscaped areas. The flexible zones are not intended to suggest that the landscaped areas will not be provided as they are a committed element of the Proposed Development.

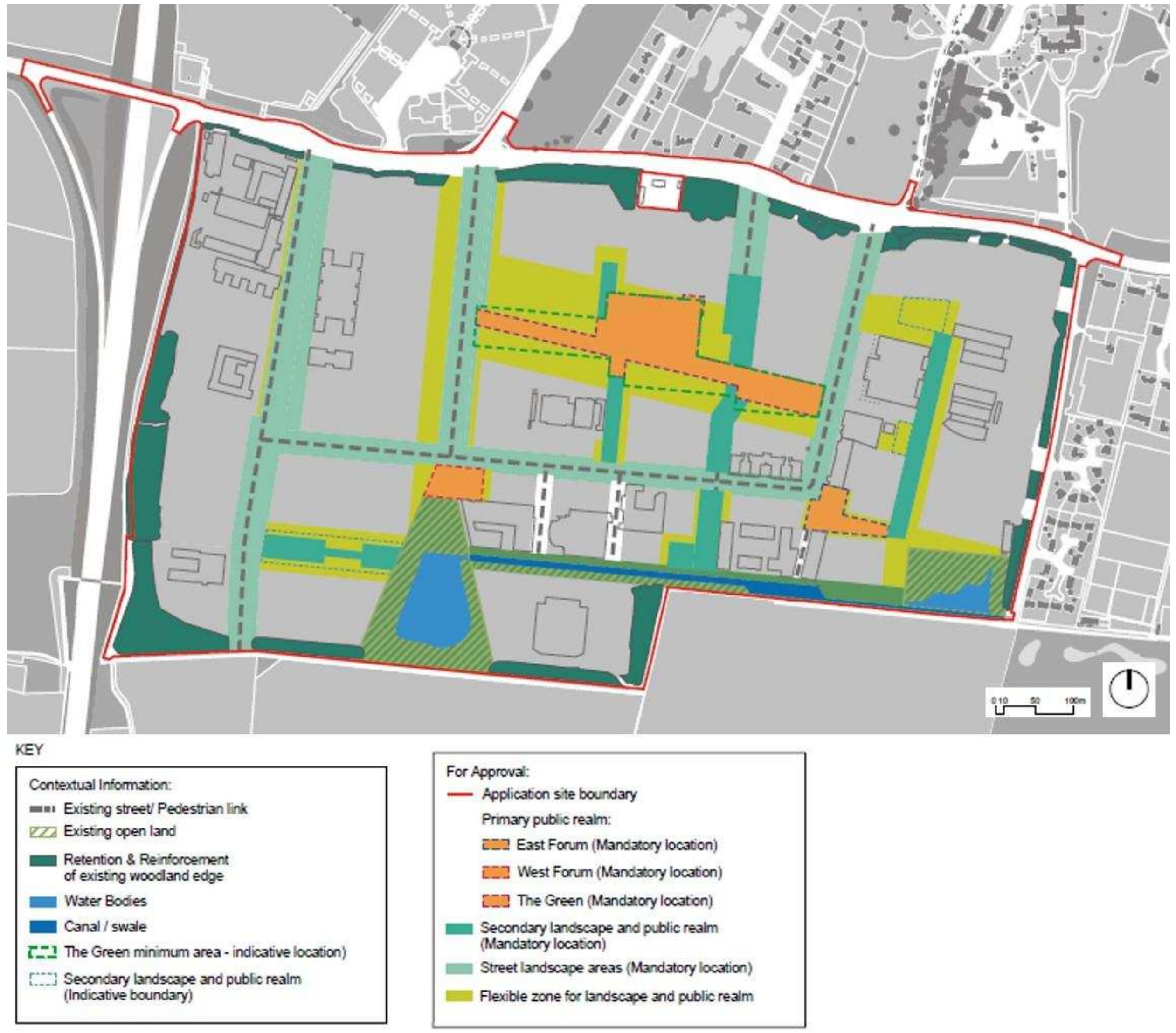


Figure 3.5 Open space and landscape strategy

Sustainability framework

3.3.14 A sustainability strategy has been produced for the Proposed Development which sets out an ambitious sustainable vision. Two of the key drivers for the masterplanning of the Site are major sustainability themes:

- To substantially improve the social realm and hence increase the well-being of those working and living on the Site;
- To improve pedestrian and cycle access to the Site and to radically improve public transport provision which enables building on the existing car parks, densifying the Site and making it more attractive to cyclists and pedestrians.

3.3.15 A sustainability framework has been developed which is a key document for guiding the Proposed Development. The framework identifies 12 sustainability objectives which are grouped into four categories as shown in Table 3.2.

Table 3.2 Sustainability principles

Category	Sustainability principle
Resources and climate change	• Energy and climate change • Water • Materials • Waste
Transport and local connectivity	• Transport and mobility
Peoples health, social, and economic wellbeing	• Health and well being • Collaboration and inclusion • Education and knowledge transfer • Employment opportunities
Land use, ecology, and local impact	• Biodiversity and ecology • Pollution and local environment • Reputation, heritage and the city

3.3.16 Each of these sustainability principles has a series of aims and objectives which guide the development of the Proposed Development to ensure that the sustainability strategy is adhered to.

3.4 Design guidelines

3.4.1 In addition to the parameter plans the emerging Proposed Development will be controlled through the Design Guidelines. These are a set of design principles which form part of the planning application and are for approval. The guidelines seek to provide consistency in design across the whole Proposed Development.

3.4.2 The Design Guidelines set out several environmental mitigation measures that are 'built-in' to the Proposed Development and which will be secured through the planning permission. The Design Guidelines include measures that are mandatory and measures that are desirable but not compulsory. To ensure that the EIA considers a 'worst case' scenario only those measures which are mandatory have been assumed to be implemented. These have been divided into the following categories:

- Controls on building design,
- Controls on planting and retention of existing vegetation across the Site,
- Measures to increase biodiversity across the Site,
- Controls on plant and storage,
- Controls on artificial lighting,
- Controls to protect built heritage,

Controls on building design

- Existing north-south streets shall be further greened using development setbacks and landscaped areas formed alongside High Cross and Western Access/Ada Lovelace Road;
- The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m;
- The frontages longer than 50m shall employ at least one of the strategies described in Figure 24 of the Design Guidelines for breaking the long frontages. The choice of one or more of the strategies will depend on the location on the site: some strategies will be better suited for the site edges (for example using planting adjacent to woodland buffers) others will be required along streets or key spaces (for example varying roof lines and building lines);
- Lengths of unbroken frontages on multi storey car parks shall be limited to 50m;
- Frontage lengths of multi storey car parks longer than 50m shall be broken by introducing one or more of the strategies and/or other measures described in in Figure 25 of the Design Guidelines, which achieve the effect of introducing variety and breaking down the frontage length;
- Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials;
- The development of continuous roof lines of consistent height along the key spaces, streets and Green Links shall be avoided and preference shall be given to compositions with varying roof lines and accents;
- Development along the Southern Edge shall respond to long distance views. Long frontages here shall be broken/varied and additional tree planting and landscape shall be introduced to provide a softer, woodland edge;
- The three north-south running streets and the Central Green Link shall have building to building width with a minimum of 30m;
- Maximum build-to lines along High Cross Avenue shall be setback from the road corridor by at least 8m on the eastern side and by at least 5m on the western side of the street (thus, together with the road corridor of 25.3m, the width between buildings along High Cross shall be minimum 38.3m in the south and 44.8m minimum in the north);
- At the southern end of High Cross Avenue, an additional frontage height restriction of 33m AOD (to the west) and 35m AOD (to the east) shall be applied. Any development above these heights shall be set back by a minimum of 5m from the primary frontage line;
- Building Zones along JJ Thompson Avenue are set to allow for a 10m buffer between the stems of the existing trees and the proposed building faces (maximum Build to Line). This provides an additional zone of minimum 4m between the edge of the road corridor and the building faces on each side. Thus, together with the road corridor width of 25.3m, the width between buildings along JJ Thomson Avenue shall be minimum 33.3m;
- An additional frontage height restriction of 33m AOD shall apply along the Western Access Road and any development above this height shall be set back by a minimum of 5m from the predominant building frontage;
- Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD;
- At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within an envelope rising by 45° angle to the parameter height of 31m AOD;
- Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development;

- Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing;
- Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting;
- Treatment of façades shall be sensitive in scale and the use of materials;
- Materials for less visible façades shall be robust and designed to age well;
- Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site;
- Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location.

Controls on planting and retention of existing vegetation across the Site

- Mandatory Trees and Hedgerows shall be retained, their root protection area uncompromised and the appropriate buffer zone (as set out in the Arboriculture Impact Assessment Report, Appendix 8.1, Volume 3) shall be provided to building edge;
- Woodland infill planting at the site edges shall be native trees and shrubs and shall be in accordance with the Woodland Management Plan, Appendix 8.4, Volume 3;
- Selective Removals: The design of new access points and service routes will require the selective removal of trees. Selective removal shall be carefully considered and designers shall demonstrate a sympathetic approach to the layout of any development for minimal tree removal. Any tree removals shall be assessed on an individual basis and addressed during reserved matters applications;
- Avenue trees to High Cross, Charles Babbage Road, JJ Thomson Avenue and Western Access / Ada Lovelace are mandatory to be retained but shall require selective removals to facilitate access to the plots or replace trees in ill health. Street tree removals shall be assessed on an individual basis and addressed during reserved matters applications and where trees are removed due to ill health planting conditions shall be improved before new planting is introduced;
- Planting at the West Forum shall reinforce the visual connection from the upper areas to the wider landscape and the Southern Ecological Corridor;
- Existing mature planting and hedgerows within the East Pond area and along the Southern edge shall be maintained with the appropriate tree buffer zone. New tree planting shall be accommodated within the East Pond space (to the north of the pond) to ensure that new development is set within landscape;
- Large feature tree planting shall be provided at a minimum of 5 key locations within The Green public open space area, such as at the gateways to The Green or key nodes within the space. Where large trees are planted, they shall be given the proper environmental conditions and space to grow to maturity;
- Large feature tree planting shall be provided at a minimum of 5 key locations along the Southern edge. Where these trees are planted, they shall be given the proper environmental conditions and space to grow to maturity and shall be provided with a 15m buffer, in accordance with the Woodland Management Plan (Appendix 8.4, Volume 3);
- Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside. Long views from the West Forum and Green Links to the southern countryside should be carefully crafted;
- Large feature tree planting shall be incorporated at key locations along High Cross, such as: the gateway to Madingley Road and the interface with The Green. Large tree species must be given the proper environmental conditions and space to grow to maturity;
- Large feature tree planting shall be incorporated at key spaces along JJ Thompson Avenue such as the gateway to Madingley Road and the interface with The Green. Large tree species shall be given the proper environmental conditions and space to grow to maturity;
- The Design Guidelines shall be read in conjunction with the Arboriculture Impact Assessment (Appendix 8.1, Volume 3) and the Woodland Management Plan (Appendix 8.4, Volume 3) and the recommendations shall be implemented;
- The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3);
- Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge.

Measures to increase biodiversity across the Site

- In appropriate locations, the public realm design shall include facilities and/or measures which allow site occupants to engage with biodiversity and ecology. These facilities may include signage and displays; educational measures and features; community gardens; rooftop gardens; and/or water features;
- Any new planting along the Southern Ecological Corridor shall be indigenous;
- To the water body edges, marginal planting shall be provided to create a natural look, increase biodiversity and provide a range of appropriate habitats. This planting shall be appropriate to the soil and environmental conditions at the water edges;
- The hedgerow alongside the Schlumberger Research Building shall be retained and, where needed, reinforced with a variety of species to create a continuous, bio-diverse hedge;
- Any new landscaped gaps between buildings along the western edge shall be a minimum of 20m from building face to building face.

Controls on plant and storage

- Rooftop plant areas shall be within the height parameters set in the height parameter plan (Figure 2.2 above);
- The impact of plant (and rooftop plant in particular) on building design and on open spaces shall be carefully considered from the concept stage of design;
- Wherever possible, plant shall be placed on roofs in locations where it will not be visible from the public realm;
- Any plant required to be provided as a separate structure shall not be located next to or within the key open spaces;

- Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter;
- Long distance views shall be considered in the location of plant;
- Plant should be considered as a way to add variation and interest in the roofscape;
- Medium and large plant shall be considered as part of architectural concepts and building massing as an additional storey of the building. The roof plant will unavoidably be visible from public realm and so shall be treated with appropriate materials;
- Visual impact of large plant areas shall be reduced by breaking their volume and providing variation in rooflines;
- Any parts of building facade related to plant shall not be inferior to the rest of the facade in materials and treatment;
- If larger flues are required, they shall be treated as part of the architectural concept design and placed in locations that do not overwhelm key open spaces;
- Consideration shall be made so that rooftop plant spaces do not dominate the views from within the Southern Ecological Corridor: plant shall be set back, screened, treated as part of the facade or otherwise carefully treated to minimise visual impact;
- Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed;
- Rooftop plant shall not be located within the 32m AOD zone along Madingley Road;
- Any rooftop plant within 20m of the Southern edge of the woodland buffer shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road;
- Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road;
- Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south;
- Rooftop plant shall be set back from the predominant building line adjacent to Clerk Maxwell Road or effectively screened.

Controls on artificial lighting

- Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone;
- An artificial lighting scheme shall be submitted with each reserved matters application.

Controls to protect built heritage:

- The Listed Schlumberger Research building shall remain the primary landmark for the site. New development and spaces shall work together to define a new and appropriate setting for this building;
- A view corridor with a minimum 20m width will be preserved between JJ Thomson Avenue and High Cross to protect views through the Site of the Schlumberger Research Building;
- On the west side of High Cross, the Listed Schlumberger Research building shall remain visible as a key site landmark;
- In the central part of High Cross Avenue, a zone of lower development height shall be established to maintain the views of the Schlumberger Research building roof structure. The exact positioning of this lower zone shall be such to allow views of the roof-line (tent structure) from The Green;
- External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings;

Trees to be retained

3.4.3 The Design Guidelines specify several trees that are key to the landscape of the Site due to their age, condition, or prominence and must be retained. These are shown on Figure 3.6. The Arboricultural Impact Assessment in Volume 3 Appendices details the individual trees which will be retained.

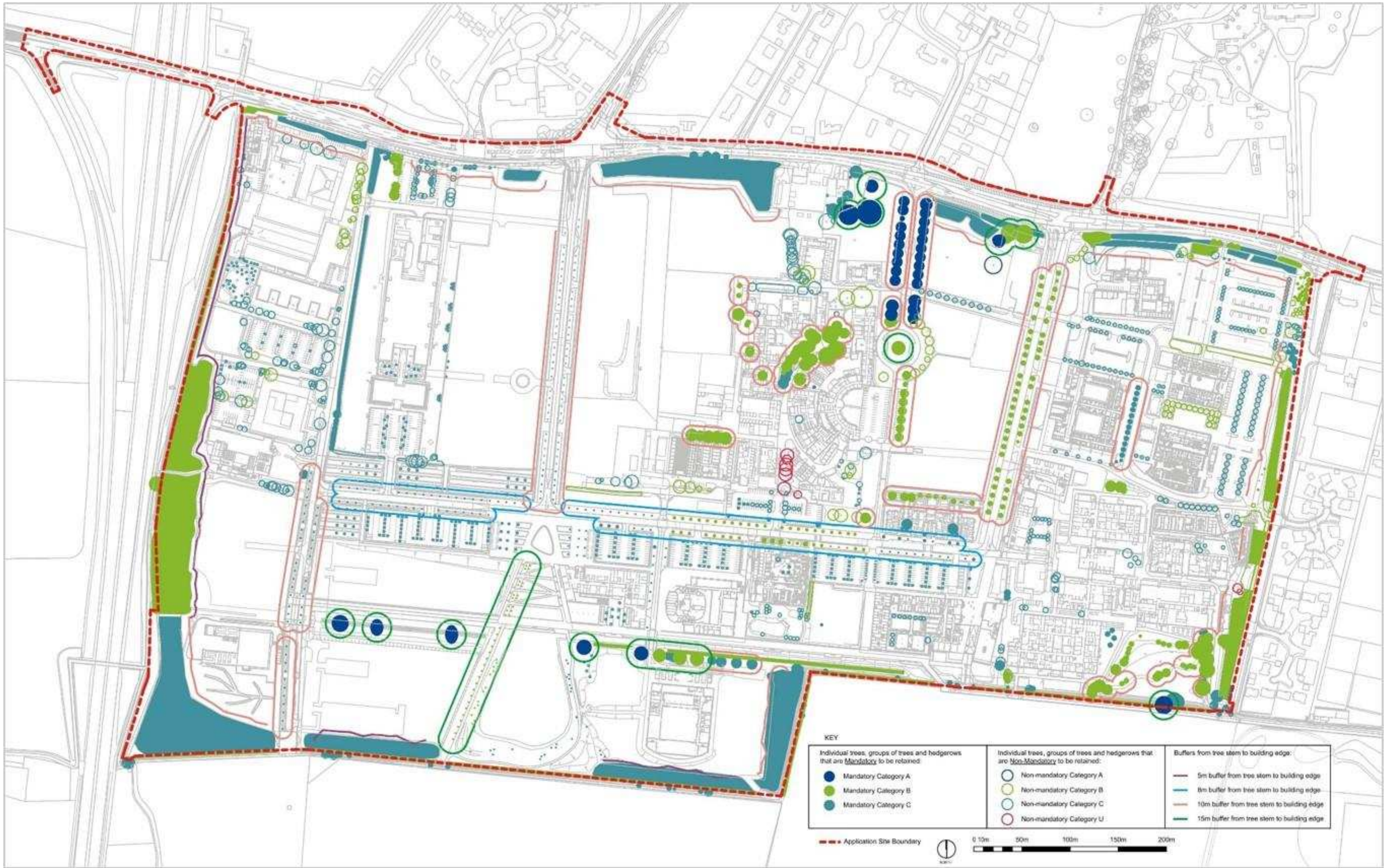


Figure 3.6 Trees to be retained

3.5 Woodland Management Plan

3.5.1 In addition to the Design Guidelines, there is a Woodland Management Plan (Volume 3, Appendices) which details management measures to promote the woodland buffers on the boundaries of the Site. The general principles are to manage the woodland buffers to promote screening and limit visibility into the site where there are near views, such as along Madingley Road, and promote legacy trees in areas where long distance views are more sensitive such as along the southern boundary.

3.6 Energy strategy

3.6.1 The energy strategy has been updated to allow for greater flexibility. The energy strategy is now based on a hierarchical approach with the preferential solution to be a site-wide heat and power network. If this is not possible the next preferential solution is to adopt a cluster approach where buildings are grouped together and smaller heat a power networks are established within the clusters. If this not possible then the next favourable solution is to adopt a building by building approach where each building generates its own heat and power requirements.

3.6.2 The site wide solution remains as put forward in the planning application in 2016, with the buildings linked together via a heat network and a single large energy centre proposed to deliver most of the heat to the Site. This would be served by gas CHP in the short to medium term, but with the option to replace this with another technology at a later date when this becomes preferable. These solutions could include ground or air source heat pumps.

3.6.3 The cluster or precinct solution recognises the benefit of linking several buildings together. These apply particularly where they are close together and ideally having differences in their requirements for heat and cooling that may enable further efficiency savings. There could be options to serve these clusters either with gas CHP or heat pumps supplemented with gas fired boilers.

3.6.4 The individual building approach may make sense for some particular buildings which are further away from others and have very low energy demands. This may mean that the benefits of linking them to others would not be sufficient to overcome the cost of the physical link between them. Individual buildings could utilise either ground or air source heat pumps, or gas fired boilers depending on demand and other conditions.

CHP energy centre

3.6.5 The Site wide solution with a central Combined Heat and Power (CHP) energy centre is the same as the energy strategy proposed in the 2016 planning application. This will comprise a gas fired combined heat and power plant with heat storage capacity. The proposed location for the energy centre is shown on the building heights parameter plan by reference to the potential location of the energy centre flue (Figure 2.2).

3.6.6 The Energy Centre has not yet been designed, so several assumptions based on similar developments elsewhere have been used for the purposes of the EIA. This enables the air quality and noise and vibration assessments to determine the likely effects and any mitigation that may be required. The assumptions for the Energy Centre are as follows:

- The energy centre will have 3 CHP engines together with gas fired boilers to provide supplementary heat and to cover peak demand when the CHP is unavailable.
  - Illustrative CHP plant – 3 no. 2.6 MW Jenbacher Type 6.
  - Illustrative boiler plant – 3 no. 10MW and 1 no. 5MW Cochran Thermax.
- The CHP will operate for up to 17 hours per day.
- Two operational modes as follows:
  - Mode 1 – 34MW boiler capacity, no CHP capacity to represent a situation of peak winter demand with all CHP engines being off line.
  - Mode 2 – 7.8MWth CHP capacity (all three engines) and 26.2 MW boiler capacity to represent a peak winter demand with all engines operating.
- Total operating capacity will be kept below the 50MW thermal input threshold for Pollution Prevention Control (PPC) permitting.

Air source heat pumps

3.6.7 Air source heat pumps are roof top plant that extract heat from the surrounding air. The system requires a large amount of roof space to achieve sufficient heat exchange and have fans which can be noisy. For the purposes of the EIA the following specifications have been assumed for the purposes of noise impact assessment:

- One air source heat pump has been assumed on top of each building which is located within 500m of the receptors.
- For the purposes of the assessment it has been assumed that Güntner Axial drycoolers 067B/2X4 will be used. Page 6 of the data sheet specifies a sound pressure level of 55dB at 10m. This is the worst case noise level from the plant options and the final design may differ.
- It has been assumed that there will be no noise shielding of the air source heat pumps which will be located on the edge of the roof.

Ground source heat pumps

3.6.8 There are two types of ground source heat pump which will be considered in the energy strategy:

- Open loop system
- Closed loop system

3.6.9 The open loop system comprises a borehole drilled down to reach a large body of water (aquifer). Water is then pumped up to the surface and used to warm the cold side of the heat pump. The cooled water is then re-injected into the ground through a second borehole at sufficient distance from the first to avoid a 'short-circuit' with the same water being made colder and colder.

3.6.10 The closed loop system comprises several boreholes drilled to depth and pipes inserted. A fluid is passed through these to extract warmth from the ground, and this fluid is used to warm the cold side of the heat pump.

3.6.11 In contrast to the air source heat pump there is in general no requirement to use space on the roof for heat exchange and the plant can be located wherever is most appropriate. There must be a connection to the boreholes (known as the ground loop), but this can all be hidden below ground.

3.7 Surface water drainage

3.7.1 The topography of the Site falls from the ridgeline that runs east-west through the Site. Surface water to the north of the ridgeline is directed to Madingley Road and south of the ridgeline to the ecological corridor. The existing drainage network will be used as far as possible to minimise the need to construct new infrastructure.

3.7.2 Post submission discussions with officers identified concerns from the Local Lead Flood Authority regarding the potential effect of development on water quality. These discussions evolved around the effectiveness of the proposed SuDs measures to treat post development run off. The original FRA and Drainage Strategy proposed the use of bio retention zones for treatment of highway run off. Lakes and Ponds were to incorporate fore bays.

3.7.3 Discussions with the Local Planning Authority on proposed public realm treatments and landscaping resulted in modified landscaping proposals being submitted. As part of this exercise, it was considered that the extent of bio retention zones could be rationalised. The construction of fore bays to the Western Lake and Payne's pond were also reviewed as they could impact upon ecology of the Western Lake, Canal and Payne's pond.

3.7.4 A Technical Note was prepared which assessed the likely pollution risks from development. Where car parks are proposed, the existing SuDs measures will be supplemented by the use of proprietary systems such as Class 1 Oil by pass separators. Using the Simple Index approach set out in CIRIA C 753 The SuDs Manual it was demonstrated that the use of linked SuDs features in series ,as proposed, would enable post development flows to be treated and provide the required levels of pollution mitigation without the need for sediment fore bays.

3.7.5 A site-wide SuDs drainage strategy will be developed which integrates with existing infrastructure. It is intended to incorporate rain gardens as part of the integrated street-scape drainage and landscape strategy, wherever this is possible given the existing trees and underground service constraints. Where SuDs can be provided, water will be integral to the landscape design and provide amenity and bio-diversity benefits.

3.7.6 The following are the mandatory guidelines for the site wide SuDs approach:

- Site-wide SuDs infrastructure shall be incorporated in the external space in a manner which helps inform and educate occupants and visitors;
- Road side rain gardens shall be a minimum of 1.5m wide and 6m in length;
- Detailed designs for rain gardens shall be considered in the general locations shown in Section 03 of the Design Guidelines and shall be brought forward unless it is demonstrated that this is not technically possible or cost effective;
- Rain garden features shall be considered on a plot by plot basis for bio-retention and brought forward during detail design;
- Individual SuDs strategies for each reserved matters application shall be carried out for the benefit of water quality, biodiversity and the landscape provision. The strategies held within individual plots shall integrate with the site wide SuDs strategy;
- Engineered soils (gravel & sand layers) and enhanced vegetation shall be considered to improve treatment performance;
- Rain garden features shall be planted with a variety species appropriate for the conditions and the expected saturation level. Species shall be robust, drought tolerant, salt tolerant and preferably native grasses. Grasses with a soil-binding root structure shall be favoured along the bottom of the rain garden for their ability to aid in the filtration of pollutants and stabilize soils;
- Site wide infrastructure shall meet best practice guidance such as the Ciria SuDs Manual (C753).

3.8 Construction phase

3.8.1 Construction of the Proposed Development will occur in phases, which will be determined at a later stage depending on demand. Due to the long time frame that the Proposed Development will be developed over, a contractor has not yet been appointed. As each phase is developed a contractor will be commissioned and they will devise the relevant construction plan.

Construction activities

3.8.2 As no contractor has been commissioned yet the list of construction activities below is based on experience of the types of construction activities that would occur on any large construction site for this type of development. This is not an exhaustive description of all the construction activities that could occur but is sufficient to provide the assumptions for the impact assessments:

- Enabling works including Site clearance, establishment of a construction compound and worksites;
- Building demolition;
- Contaminated land remediation (if required);
- Earthworks to obtain the desired ground level (these are likely to be minimal);
- Excavation for foundations, services, basements etc;
- Import of construction materials, plant, and workers;
- Stockpiling and storage of construction materials and plant including fuels and chemicals;
- Concrete batching;
- Installation of new services;
- Erection of new structures and buildings;
- Piling for some structures and building foundations;
- Export of construction waste; and
- Landscaping including planting of soft landscaped areas and areas for ecological mitigation.

3.8.3 The Proposed Development will be constructed in phases likely to be over a 14 year period. The assumed opening date for all construction to be complete and the Proposed Development to be fully built out is 2031.

Building demolition

3.8.4 Many of the aging buildings on the Site do not contribute to the emerging masterplan. These buildings will require demolition to release the land for more appropriate and denser development of contemporary buildings that are constructed to modern standards. The buildings scheduled for demolition are listed below and shown on Figure 3.7:

- Cavendish Laboratory complex;
- Whittle Laboratory buildings;
- Department for Veterinary Medicine complex;
- University stores; and
- Merton Hall Farmhouse.

3.8.5 All other existing buildings on Site will be retained and integrated into the Proposed Development.

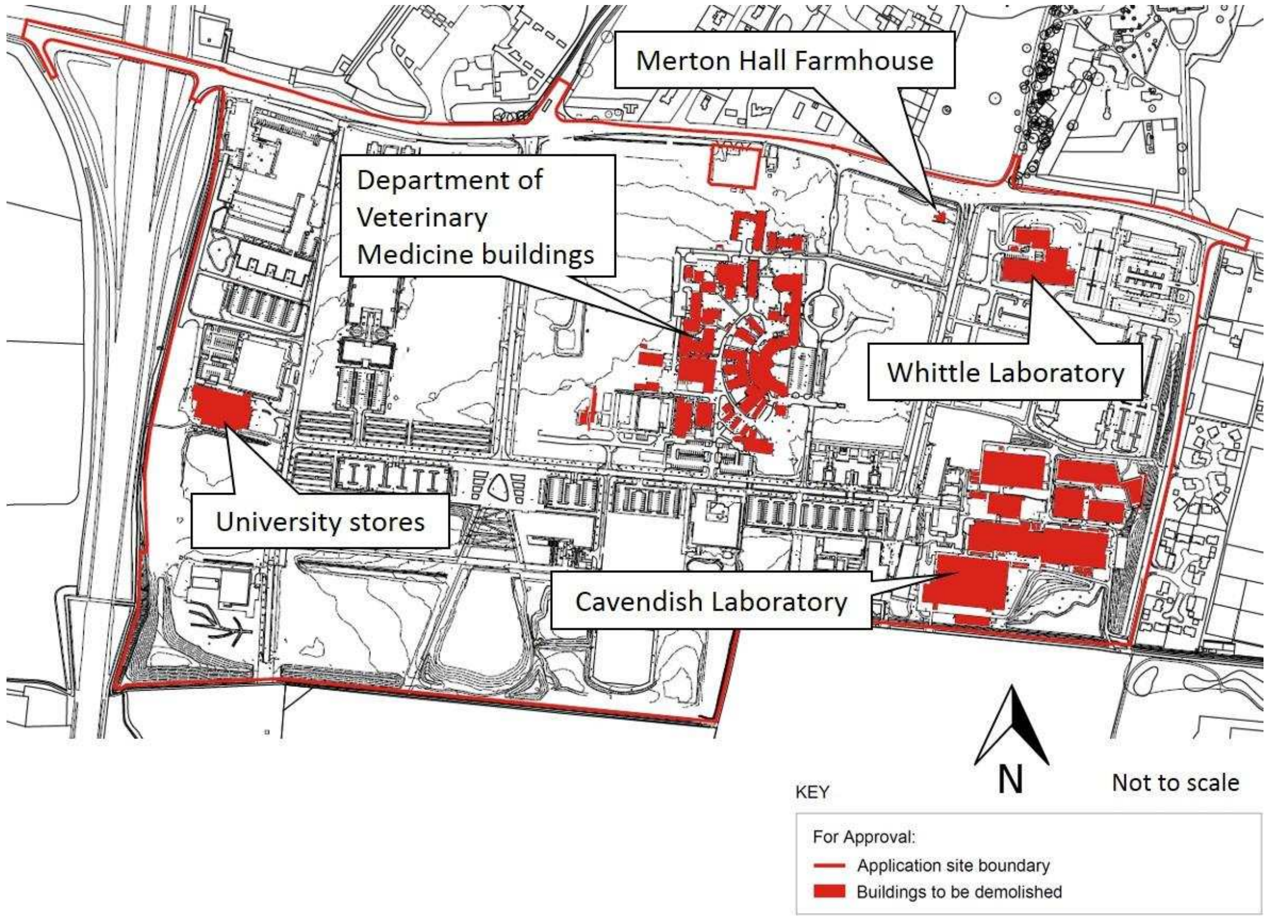


Figure 3.7 Buildings scheduled for demolition

Phasing

3.8.6 Because the Proposed Development will be built out over a 14 year period, depending on market demand, a phasing plan is currently not available. For the purposes of the transport, air quality, and noise and vibration assessments in this ES it has been assumed that the first phase will comprise several priority projects comprising the ground floor areas shown in Table 3.3.

Table 3.3 New and existing ground floor area for the first phase of the Proposed Development

Proposed land use	Ground floor area (m^2)
Academic Research (m^2)	168,259 (+ 66,000)
Commercial Research and Research Institute (m^2)	92,386 (+52,000)
Nursery (m^2)	1,900
Shop, Café Restaurant, Pub - A1-A5 (m^2)	350
Assembly and Leisure	6,060
Residential (m^2)	10,680
Ancillary Infrastructure (data centre, energy centre)	7,675 (+ 3,160)
Total (m^2)	287,310
Car Parking (spaces)	2,571

Construction Environment Management Plan (CEMP)

3.8.7 A Construction Environmental Management Plan (CEMP) has been submitted in support of the outline planning application. This sets out how mitigation measures for the construction phase identified in the ES. When a contractor is appointed for the first development on site a detailed CEMP will be prepared to cover that development. Additional CEMPs will follow for later detailed proposals and will include as a minimum:

- Site wide construction and phasing programme;
- Access arrangements for construction vehicles, plant and personnel;
- Construction hours;
- Construction delivery times;
- Soil management strategy;
- Noise and vibration monitoring requirements;
- Maximum noise levels for construction vehicles, plant and equipment;
- Maximum vibration levels;
- Dust management strategy;
- Site lighting details;
- Drainage control measures;
- Screening and hoarding details;
- Access and protection arrangements around the site for pedestrians, cyclists and road users;
- Procedures for interference with public highways including public rights of way;
- External safety and information signing and notices;
- Liaison, consultation and publicity arrangements;

- Consideration of sensitive receptors;
- Prior notice and agreement procedures for works outside agreed limits;
- Complaints procedure; and
- Location of compound and method of moving materials, plant and equipment around the site.

3.8.8 As part of the outline planning application, a Site Waste Management Plan (SWMP) has been submitted. The SWMP sets out the framework for the management of construction waste using indicative volumes and types of waste arisings calculated from the parameter plans. At the reserved matters stage, subsequent applications will be accompanied by a Detailed Waste Management and Minimisation Plan (DWMMP) for the construction phase. The DWMMP will include as a minimum:

- Construction waste infrastructure to be used on Site during construction;
- Measures and protocols to ensure effective segregation of waste at source;
- Any other steps to ensure the minimisation of waste during construction;
- Location and timing of on Site waste facilities;
- Proposed monitoring and timing of monitoring report submissions;
- Proposed timing of the submission of a Waste Management Closure Report;
- Recycling in Cambridgeshire and Peterborough (RECAP) Waste Design Guide 2012 toolkit completed with supporting reference material; and
- Proposals for the management of municipal waste generated during the occupation phase of the Proposed Development.

4. Alternatives

4.1 Submitted Proposed Development

4.1.1 The submitted ES included several alternatives which were considered throughout the design process. Now that the parameter plans and Design Guidelines have been updated, the submitted Proposed Development should now be considered an alternative.

4.1.2 A full description of the submitted Proposed Development can be found in Chapter 3 of the submitted ES and a summary of the main differences to the amended Proposed Development is provided in Section 1.2 of this document.

4.1.3 The key reason for discounting the submitted Proposed Development was the potential impacts to the landscape and visual receptors and the historic environment. The amended Proposed Development has been updated specifically to address these concerns by reducing the maximum height and massing that could be achieved on the Site and strengthening the woodland boundaries to provide better screening through a specific Woodland Management Plan (see Volume 3, appendices).

4.2 Alternative height parameter plan

4.2.1 Following the submission of the planning application the first amended height parameter plan (Figure 4.1) showed a general reduction in heights, the removal of the taller built elements, increased margins at the Site boundaries, increased north-south corridor widths, and a further reduction in height to building zones adjacent to the Site boundaries. This proposal was presented to Cambridge City Council officers and the Historic England case officer for discussion. Concerns were raised about the impact of the heights of the building zones immediately adjacent to the recently Grade II* listed Schlumberger Gould Research Centre, where it was stated that building heights on the Schlumberger plot should not exceed the height of the fabric element of the existing Schlumberger Gould Research Centre, which is 36.5m AOD. The Proposed Development has reduced the height of the entire building zone to 36m AOD to minimise the impact on the setting of the Schlumberger Gould Research Centre. Subsequent comments raised concerns about the impact on the setting of the Conservation Area. In response to these concerns, the heights of the buildings opposite the Conservation Area were reduced and stepped towards the centre of the Site to minimise the impact on the Conservation Area setting,

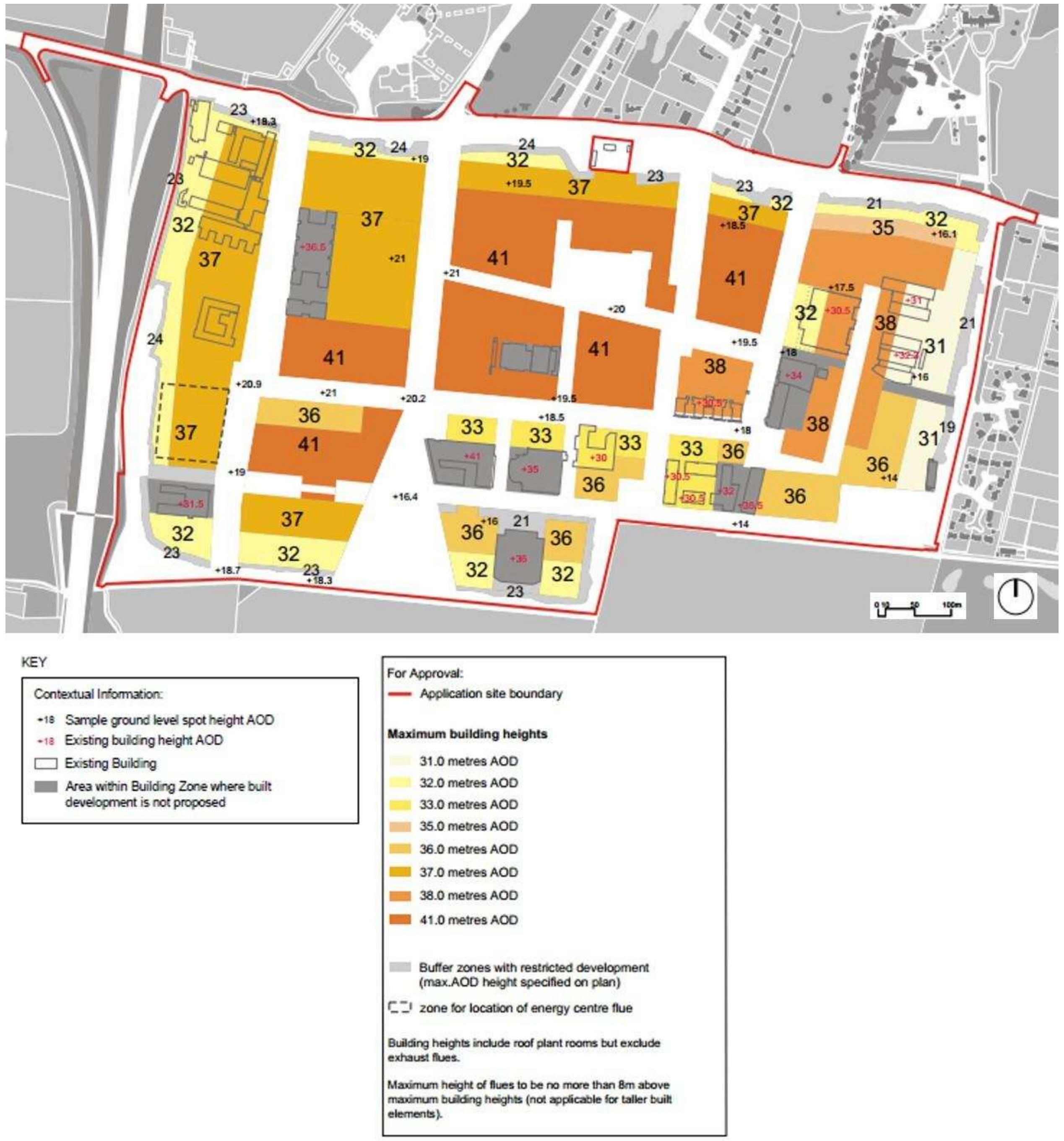


Figure 4.1 Initial amended height parameter plan considered after submission of the planning application and subsequently amended to respond to the listing of the Schlumberger Gould Research Centre

7. Historic environment

7.1 Introduction

7.1.1 This chapter provides an update to the Historic environment assessment that sets out the changes from the submitted ES that have resulted from the listing of the Schlumberger Gould Research Centre (at grade II*) and the amendment of the Proposed Development in response to comments from consultees, including Historic England and Cambridge City Council and comments received from the County Archaeologist. The aim of the amendments of the Proposed Development has been to reduce the massing of the proposed buildings and better respond to the setting of the Schlumberger Gould Research Centre. The following sections remain unchanged from the submitted ES and have not been replicated within this document.

- Scope of assessment;
- Relevant legislation and policy;
- Method of assessment.

7.1.2 A new section has been added summarizing the recent key design changes to the Proposed Development, in relation to the historic environment.

7.1.3 The baseline conditions section is amended by the addition of more detail concerning some heritage assets where it is considered that this is necessary to provide a clearer analysis of their settings and significance. Only the altered baseline descriptions for those particular heritage assets have been included in this Addendum.

7.1.4 Those heritage assets for which amended baseline descriptions are included here are:

- White House;
- The Observatory & Northumberland Dome at the Observatory;
- Conduit Head Road Conservation Area;
- West Cambridge Conservation Area and its constituent listed buildings;
- The Schlumberger Gould Research Centre;
- Merton Hall Farmhouse.

7.1.5 The following sections have been updated below to reflect the listing of the Schlumberger Gould Research Centre, further research into its significance and the amendments to the Proposed Development, that have been introduced to reduce the massing of the proposals and safeguard the settings of the heritage assets, and due to comments received from the County Archaeologist:

- Impact assessment;
- Mitigation measures;
- Summary.

7.2 Recent changes to the Proposed Development

7.2.1 In response to consultation comments, including those provided by Historic England in a letter of 12th August 2016 and discussions at a meeting with on 9th May 2017, there has been some revision to the Proposed Development as set out in Chapter 2.

7.2.2 The revisions relating to the historic environment assessment include:

- Maximum heights, especially around the peripheral blocks, have been reduced;
- There are no longer 8m high taller built elements proposed that rise above the general building heights;
- Central roadways and open space have been refined to maintain and provide long views of the Schlumberger Gould Research Centre from the west;
- Blocks adjacent to the Schlumberger Gould Research Centre have been reduced in height to ensure that the Schlumberger Gould Research Centre is taller.

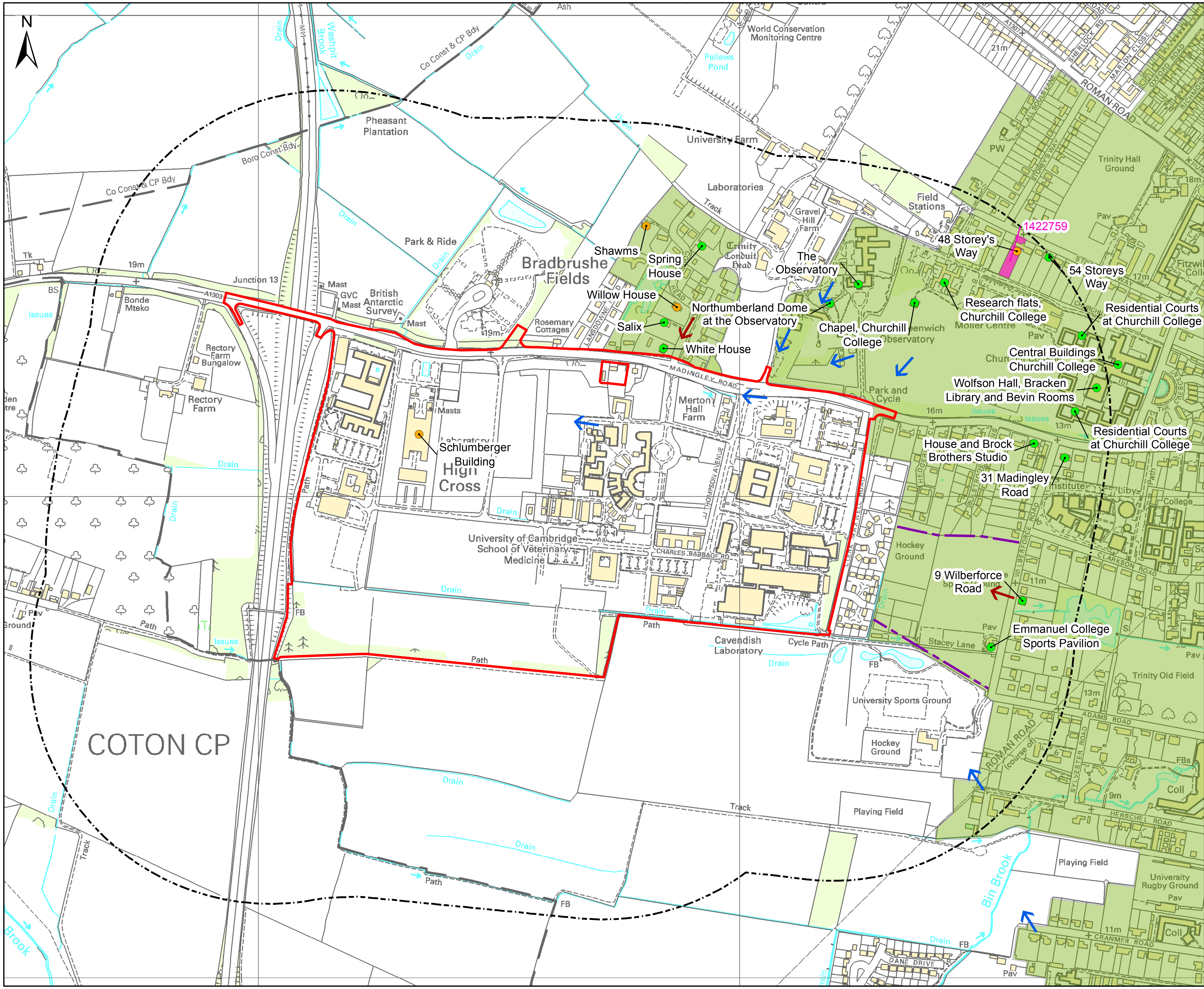
7.2.3 There is no proposed development block on the site that has more storeys than buildings that are already on the site.

7.3 Amended baseline conditions

7.3.1 Updated descriptions of the significance and setting of the heritage assets listed in Section 7.1 are set out below. Figure 7.1 (Figure 7.2 in the submitted ES) has been amended to show the additional analysis with regards to views and settings associated with the built heritage assets.

White House

7.3.2 The White House is a grade II listed two storey house with a third storey set back at the centre of a roof terrace, built in 1930 by George Checkley in the International Modern style. The house has a rectangular plan with central entrance hall. The facades are white painted brick and the roof is flat concrete. It is the southernmost building in Conduit Head Road Conservation Area. It is visible and accessed from its drive gate on Conduit Head Road. The property boundary is heavily screened to the south and south east by an evergreen tree screen and dense hedges. This screening contains the landscaped gardens that are hidden from view from Madingley Road to the south and are mostly screened from Conduit Head Road to the east. The roadway in front of the house and the suburban character of Conduit Head Road also form part of the setting of the White House and make a moderate contribution to its significance. The proposed development site is visible from the roadway of Conduit Head Road, in front of the White House's gates behind a tree screen that partly closes the views southwards. Figure 7.2 shows the heavy screening from Madingley Road.



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- Site boundary
- 500m Built Heritage Study
- Key Views Discussed
- Views Discussed
- Boundary Road Views from Wilberforce Road

Listed Buildings

- Grade II*
- Grade II
- Registered Park & Garden
- Conservation

0 100 200 Metres

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Client: University of Cambridge

Project: West Cambridge Masterplan EIA

Title: Built Heritage Assets Figure 4.2

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Figure 7.2 Close up view towards White House from the north edge of Madingley Road's north carriageway showing the density of the planting in Winter

The Observatory & Northumberland Dome at the Observatory

7.3.3 The Observatory and the Northumberland Dome are both grade II listed. The Observatory was commenced in 1822 by the architect John Clement Mead. The Neo-Greek style, two storey building is ashlar stone faced and has slate and lead roofs. Built on a half H shaped plan, with wings extending northwards, it has a southern projecting central tetrastyle Doric entrance portico. It has a small movable dome located in the centre of the building. The slightly later Northumberland Dome was constructed around 1838 and is faced in white brick with a movable copper dome and has since been reconstructed. It is located in the grounds of the Observatory. Both buildings are heavily screened from the Proposed Development site by tree plantations. Beyond the screening, along the western side of the Observatory site there are modern research buildings. This area plays no visual role in the settings of the listed buildings. Although there are views from the western part of the site towards the Proposed Development these, make no contribution to the listed buildings' significance. The main drive from the Observatory's central portico to Madingley Road is narrow and orientated north-north west to south-south-east, effectively aligned so that constricted views are away from the Proposed Development to its north-east corner. Figure 7.3 shows the tree view towards the Proposed Development from the area of modern research buildings along the west edge of the Observatory site. Figure 7.4 shows one of the tree screens south west of the Northumberland Dome. Figure 7.5 shows the view along the driveway from The Observatory, towards the Proposed Development.

Figure 7.3 View towards the proposed development site from the modern western edge of the Observatory site

Figure 7.4 Part of the heavy conifer tree screening south west of the Northumberland Dome (winter)

Figure 7.5 View looking SSE along the Observatory's access drive, near its junction with Madingley Road.

Conduit Head Road Conservation Area

7.3.4 The Conservation Area comprises 20th century suburban residential development, built in a piecemeal fashion from approximately 1914. Its significant elements lie to the west of the main straight, southern part of Conduit Head Road, that extends north from Madingley Road. The western part of the Conservation Area contains all of its five listed buildings. Of particular interest are the Modernist, White House, Salix House and Willow House, all set within their private grounds, which are generally bounded by thick vegetation, including the 'Wilderness', an area of dense tree growth to the west of these houses. The area to the east of the main straight, southern part of Conduit Head Road is included in the Conservation Area. However, it's buildings are of no architectural or historic interest (dating to the 1990s), and they appear to contribute to the character and appearance of the Conservation Area only in as far as they preserve the suburban nature of Conduit Head Road adjacent to three of its five listed buildings.

7.3.5 The area outside of the Conservation Area to the south and east of these 1990s buildings therefore plays little to no part in the significance and therefore the setting of the Conservation Area, other than providing a suburban buffer of domestic scale houses to the core of the Conservation Area. The fields to the north and west of the Conservation Area contribute strongly to its setting and the field to the east of the 1990s buildings protects the buffering effect of those buildings where there are limited views eastwards between the 1990s buildings from the roadways in front of Willow House, Salix House and White House. The southern boundary of the White House, the nearest of the Conservation Area's significant buildings to the Proposed Development, is heavily screened from Madingley Road. The only element of the setting of Conduit Head Road Conservation Area that includes the Proposed Development where there is sensitivity, is at the southern end of Conduit Head Road, where the tree screens along the south side of Madingley Road thin out locally, although they (and the Veterinary School) partly close the views southward from in front of the listed buildings. This makes a moderate contribution to the significance of the Conservation Area as a whole. In relation to approaches towards the road junction of Madingley Road and Conduit Head Road, along Madingley Road from both directions the tree screens, with some thin areas, along the south side of Madingley road make a small to moderate contribution to the Conservation Area's significance, as there are tree screens on both sides of the main road, preserving its largely suburban nature, although the presence of the Observatory Site and the West Cambridge Site mean that that the Conservation Area has always sat between areas with a distinct and strong collegiate character, partly defined by the larger scale university buildings. Figure 7.6 shows winter views along Conduit Head Road looking towards the Proposed Development.

Figure 7.6 View looking south along the straight part of Conduit Head Road towards the Proposed Development Site.

West Cambridge Conservation Area and its constituent listed buildings

7.3.6 The Conservation Area is notable for its spacious residential streets lined with large mainly detached 19th and 20th century houses. A variety of college and university buildings are included in the Conservation Area. Despite the differences in the form, scale and materials between the residential and collegiate buildings the very high quality of nearly all the structures ensures that the area retains spatial cohesion. Green open spaces, including agricultural land and the college playing fields and tennis courts also contribute to the Conservation Area's significance. The Conservation Area is located to the east, south east and north of the Proposed Development Site.

7.3.7 The relationship between the significant areas of the westernmost part of the Conservation Area, north of Madingley Road (Consisting of the Observatory site) and the Site are discussed in Section 7.3, and it is concluded that the Site plays little role in the setting of this part of the Conservation Area. East of the Observatory is Churchill College. Its main buildings are some distance from the Site. However, there are fairly clear views across its land towards the Site. These views are of the current sparse tree screen in the Site's north east corner and the quite dense late 20th/early 21st century University buildings on its west edge.

7.3.8 To the south of Madingley Road the residential development within the Conservation Area to the north of Emmanuel College Sports Ground is generally two storeys high, on narrow, intimate roads with mature gardens with mature trees, with few or no views of the Site. The listed buildings in this area have no setting relationships with the Site. The western edge of the Conservation Area is generally poor where it adjoins the Site on Clerk Maxwell Road.

7.3.9 There are views towards the Site along Wilberforce Road, to the south of its junction with the north boundary of Emmanuel College Sports Ground and from the land to the West of this part of Wilberforce Road, which mostly consists of the sports ground itself (for the extent of these views from Wilberforce Road and the land within the Conservation Area to its west, see Figure 7.1 and Figure 7.7, and View Point 6 in the ES). There are two listed buildings in this area: 9 Wilberforce Road, a 1930's modernist brick house; and Emmanuel College Sports Pavilion. The views within this part of the Conservation Area, which characterise its local setting, consist of two storey modern housing beyond the boundary of the Conservation Area, above which rises the university buildings of the Site beyond. Further south than the junction of Adam Road, views are limited from within the Conservation Area, with the buildings and planting of the Hockey Ground and residential development to the west of Bin Brook interrupting views, which generally only exist patchily on the very edge of the Conservation Area.

7.3.10 The Conservation Area Appraisal explains that the Conservation Area is centred on the spine of Grange Road and that the contrast between the Conservation Area's domestic buildings and its large university buildings is an important element of its character.

7.3.11 In terms of setting, the Conservation Area Appraisal (pp. 12-13) states that:

- The setting to the west of the Conservation Area consists of open fields, woodlands or sports fields with some areas of modern development accessed from Madingley Road,
- The Cambridge Landscape Character Assessment describes the high quality of the urban edge between the Conservation Area and the countryside where the west edge is rural,
- The West Cambridge University site has cutting edge 21st century buildings,
- The domestic scale of much of the Conservation Area provides an important contrast with the large scale university buildings.

7.3.12 In relation to the analysis in the Conservation Area Appraisal, the setting of the western edge of the West Cambridge Conservation Area, along the west edge of Emmanuel College Sports Ground, is not open fields, sports fields or woodland. The contrast between the University buildings on the Site and the domestic buildings within the Conservation Area is characteristic of the contrast between university buildings and domestic housing found throughout the Conservation Area.

Figure 7.7 View from the corner of Adams Road and Wilberforce Road towards the West Cambridge site, over Emmanuel College Sports Ground

Schlumberger Gould Research Centre

7.3.13 The Schlumberger Gould Research Centre was designed by Michael Hopkins. The main tented structure was built in 1985 with a new building was added in 1992. It has recently been listed grade II*. It is one of several Hopkins' tented structures. It is set within the Masterplan site, near its western edge. The building has three fibreglass 'tents' supported by a skeletal external framework. To its west is the British Antarctic Survey, which predated the Schlumberger Gould Research Centre, and another building to the former's south. It is set in open fields to its west, beyond which are the university buildings comprising the Department of Veterinary Medicine. D Jenkins[1] mentioned that it was Hopkins' task to find the site. His practice looked at several sites around Cambridge and chose the site for its:

- Proximity to transportation links (the M11),
- Location on a designated science park, owned by the university, and

[1] D Jenkins, "Architecture in Detail: Schlumberger Cambridge research Centre", Phaidon (London) 1993

- Its proximity to other established research establishments (e.g. the British Antarctic Survey)

7.3.14 The choice of site was therefore practical rather than related to it setting.

7.3.15 An extended essay of October 1992[2] discussed the early 1990s extension to the building. In the Architect's account section, written by Michael Hopkins, Hopkins noted that the nature of the research techniques had changed from experimentation to theoretical and computer based studies. This reduced the need for related buildings to be connected, which led to the establishment of a masterplan for the future development of the High Cross site based on a campus design of separate and related buildings. In the same essay, John Winter in his Appraisal section describes the Site as a typical 1980s urban fringe business park. He mentions that Hopkins resolved the fact that the building makes a statement but has no frontage, by turning the site into an embryo campus with the eastern two thirds of the site left free for future buildings and sports facilities.

7.3.16 The existing setting, with the building sitting with open space to one side, was therefore not the design intent for the building.

7.3.17 Although there are long views of the building from within the Site (to the west of the Veterinary School), there are no longer views from further east within and to the east of the Site, within West Cambridge Conservation Area. There are, however, some oblique views from the south. The setting relationship with the British Antarctic Survey is therefore significant, as the relationship was one reason for the choice of the site, and the fact that the building can be discerned as being Architecturally distinct among the surrounding buildings of the developing campus is also a contributing element of its setting. The wide open spaces to the east of the building, however, were never intended and contribute little to the building's significance, other than making it visible within the campus

Merton Hall Farmhouse

7.3.18 The farmhouse is of low significance. It is a standard white brick double fronted two storey mid-19th century farmhouse. The building is a common type both regionally and nationally. The building has been much altered internally and its rear extensions are poor quality. It is largely screened from Madingley Road by trees. The frontage of the building faces east and it is in views from the east that it maintains its relationship with Madingley Road. Historically there were ranges of buildings forming a courtyard to its south that were demolished in the 1950s and replaced by new buildings. These were themselves demolished in the early 2000s and replaced with a temporary catering facility that was cruciform in plan. This building was demolished in 2013/2014. The Farmhouse is therefore out of its historic context, as it now stands alone with a grassed area where the associated buildings once stood.

7.4 Impact assessment

Construction phase

7.4.1 With regards to the construction phase the only change is to the value of the Schlumberger Gould Research Centre due to the recent grade II* listing. All other impacts remain the same as the submitted ES. Table 7.1 provides an updated construction assessment for the Schlumberger Gould Research Centre

[2] Various Authors, "Building Study: Technology Stretching High-Tech" *The Architects' Journal Vol. 196* 28th October 1992, 31-42

Table 7.1 Construction phase impact assessment for the Schlumberger Gould Research Centre only.

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Archaeology						
Site 1 (Iron Age)	High	Construction and landscaping activities that require excavations for basements, foundations, services, drainage or changes to ground levels will adversely affect the heritage assets within the site through physical disturbance resulting in the loss of the asset.	• Through the 2015 field evaluation already undertaken, Site 1 has been sufficiently excavated and a written record of the asset has already been produced. No further mitigation is required to preserve the site's heritage significance.	Minor	Construction and landscaping activities that involve groundworks will result in the loss of buried assets. The significance of the asset has been preserved through a written record produced during the field evaluation	Slight **Not significant**
Site 2 (Iron Age)	High	Construction and landscaping activities that require excavations for basements, foundations, services, drainage or changes to ground levels will adversely affect the heritage assets within the site through physical disturbance resulting in the loss of the asset.	• In addition to the written record produced during the 2015 field evaluation, a full open area excavation will be undertaken prior to construction works commencing. This will be agreed with the County Council's Historic Environment Team (CHET). • Dissemination and Post-Excavation – In conjunction with the excavations there will be a full programme of post-excavation, including site-by-site assessment reportage and, following analysis, appropriate publication of the results (as agreed with CHET); the archive, along with the finds, will be deposited in the County Council store. In terms of public outreach, regular fieldwork-update bulletins will be issued on the project's web-site and there will be a public open-day held at Site 2.	Minor	Construction and landscaping activities that involve groundworks will result in the loss of buried assets. The significance of the asset will be preserved through a written record from a full open area excavation.	Slight **Not significant**
Site 3 (Iron Age/Roman)	High	Construction and landscaping activities that require excavations for basements, foundations, services, drainage or changes to ground levels will adversely affect the heritage assets within the site through physical disturbance resulting in the loss of the asset.	• Mitigation for Site 2 will further expose the field system which will be recorded. Additional trenching will be undertaken to establish the system's basic layout and, locally, there will be open-area excavation to detail its layout; Written Scheme of Investigation to be agreed with CHET. • Dissemination and Post-Excavation – In conjunction with the excavations there will be a full programme of post-excavation, including site-by-site assessment reportage and, following analysis, appropriate publication of the results (as agreed with CHET); the archive, along with the finds, will be deposited in the County Council store. In terms of public outreach, regular fieldwork-update bulletins will be issued on the project's web-site and there will be a public open-day held at Site 2.	Minor	Construction and landscaping activities that involve groundworks will result in the loss of buried assets. The significance of the asset will be preserved through a written record from mitigation undertaken for site 2 combined with additional trenching if required.	Slight **Not significant**
Vicar's Farm	High	Construction and landscaping activities that require excavations for basements, foundations, services, drainage or changes to ground levels will adversely affect the heritage assets within the site through physical disturbance resulting in the loss of the asset.	• Preservation by record will occur by adhering to a suitable Written Scheme of Investigation to be agreed with CHET. • Dissemination and Post-Excavation – In conjunction with the excavations there will be a full programme of post-excavation, including site-by-site assessment reportage and, following analysis, appropriate publication of the results (as agreed with CHET); the archive, along with the finds, will be deposited in the County Council store. In terms of public outreach, regular fieldwork-update bulletins will be issued on the project's web-site and there will be a public open-day held at Site 2.	Minor	Construction and landscaping activities that involve groundworks will result in the loss of buried assets. The significance of the asset will be preserved through a Written Scheme Investigation to be agreed with CHET.	Slight **Not significant**

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Nano Fabrication Building Site	High	Construction and landscaping activities that require excavations for basements, foundations, services, drainage or changes to ground levels will adversely affect the heritage assets within the site through physical disturbance resulting in the loss of the asset.	• Preservation by record will occur by adhering to a suitable Written Scheme of Investigation to be agreed with CHET. • Dissemination and Post-Excavation – In conjunction with the excavations there will be a full programme of post-excavation, including site-by-site assessment reportage and, following analysis, appropriate publication of the results (as agreed with CHET); the archive, along with the finds, will be deposited in the County Council store. In terms of public outreach, regular fieldwork-update bulletins will be issued on the project's web-site and there will be a public open-day held at Site 2.	Minor	Construction and landscaping activities that involve groundworks will result in the loss of buried assets. The significance of the asset will be preserved through a Written Scheme Investigation to be agreed with CHET.	Slight **Not significant**
Built heritage						
Schlumberger Gould Research Centre Commercial research centre and office designed by Michael Hopkins and completed in 1985. The building is a tented structure suspended between a 'cat's cradle' arrangement of struts and supports. The building is both technically innovative, and a highly sculptural treatment for a late 20th century commercial building.	High	The significance of the Schlumberger Gould Research Centre lies in its position as an early and highly articulate example of a High-Tech building, by one of that style's leading British proponents. The technical innovation embodied in its design also contributes to the building's significance. Setting makes a limited contribution to the significance of the building. The construction will envelope the building on all sides, altering its currently relatively tranquil, semi-rural setting. This will hamper the appreciation of the building The architectural significance of the building will remain unaffected.	• No mitigation is proposed	Minor Adverse	Construction activities will reduce the appreciation of the building by limiting existing views resulting in a temporary adverse effect.	Moderate adverse **Significant**

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Operational phase

7.4.2 Table 7.2 details the impacts and effects on built heritage assets during operation only as no effects will occur to archaeology. For the built environment, only those assets which will receive adverse or beneficial effects are shown in the Table 7.2. For the full assessment on all historic environment assets see Appendix 7.2, Volume 3 of the ES.

Table 7.2 Operational phase effects

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Central Cambridge Conservation Area and designated assets within the Conservation Area boundary. The central Conservation Area covers the historic core of the city, open spaces including the college backs, Jesus Green, Midsummer Common and the Botanic Garden. The Conservation Area appraisal states that this 'interplay of grand college buildings and verdant landscape is perhaps the most enduring image of central Cambridge.' The central Conservation Area also includes some fine examples of 19th century domestic development, particularly surrounding the railway station.	High	The Proposed Development will be largely not be visible from most of the Conservation Area, which due to the nature of its topography and tight urban grain has constrained outward views. It will not feature in views from the Backs, for example, or from any of the college courts, which are highly significant open spaces within the Conservation Area. However, some taller elements of the Proposed Development, may be visible from limited elevated points within the Conservation Area, particularly from Castle Hill. In these views, it will appear as a distant element and very small element in views, which will be dominated by the architecture of central Cambridge, such as Kings College, Great St Mary's Church and the university library towers. The Tall Buildings Study identifies some key views of Cambridge from the south, particularly from the Gog MaGog hills. Any tall visible elements will form a very small element in the views compared with the architecture of central Cambridge. In relation to the significance of the Conservation Area as a whole, which is wide and multi-faceted, the setting impact would be negligible.	• At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45° angle to the parameter height of 31 m AOD; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • Woodland infill planting at the site edges shall be native trees and shrubs and shall be in accordance with the Woodland Management Plan, Appendix 8.4, Volume 3; • Rooftop plant shall be set back from the predominant building line adjacent to Clerk Maxwell Road or effectively screened.	Negligible to Minor Adverse	Some glimpsed views of the few tall elements of the Proposed Development would be visible from limited elevated points within the Conservation Area, although they would be subordinate in views to nearer and prominent buildings in the centre of Cambridge. This would result in a permanent adverse effect.	Negligible to Slight Adverse **Not significant**

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Shawms (1268363) Grade II* listed. Two storey house in the Modern Movement style with a single storey roof conservatory. The entrance has a projecting porch hood supported on two steel posts.	High	Shawms features extensive glazing to its south front, which faces over landscaped grounds to the Site. Views to the south are largely blocked by mature planting and intervening buildings. However, the Proposed Development will feature in restricted views to the south west, slightly altering the setting of the asset.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge. • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings; • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road.	Minor Adverse	Glimpsed views of the Proposed Development will result in a permanent adverse effect to the setting of the building.	Slight Adverse **Not significant**

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
White House (1126037) Grade II listed. See Section 7.3.	Medium	Views to the Site are largely screened by boundary planting, however the Proposed Development will feature in the setting of the asset, especially in views from the roadway in front of the building. The presence of large University buildings on the West Cambridge site currently forms part of the setting of the building, with a very light boundary tree screen on the south side of Madingley Road within the views along Conduit Head Road. With the denser proposed planting buffer on the Proposed Development site boundary on Madingley Road and the new buildings closer to the Madingley Road Boundary, the new buildings would be visible above the buffer screen, so the university buildings will be more imposing within the setting than currently.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge; • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings; • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road; • Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road.	Moderate Adverse	Closer views of the Proposed Development will result in a permanent adverse effect to the setting of the building, which will be partly offset by the thickened planting screen.	Moderate Adverse **Significant effect**

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
The Observatory (1126156) Grade II listed See Section 7.3.	Medium	The Observatory's two listed buildings are screened from view from the Proposed Development. The modern western fringe of the Observatory site has views of the Masterplan site and these contribute little to the buildings' significance. Restricted, narrow views along the access drive will largely be towards the thickened tree/planting screen in the north east corner of the site. The setting's contribution to the significance of the buildings will therefore be slightly affected	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge; • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings; • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road; • Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road.	Minor adverse	Views along the narrow access road will be slightly altered with a permanent adverse effect to the setting of the Northumberland Dome.	Slight adverse **Not significant**

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Northumberland Dome at the Observatory (1126157) Grade II listed. See Section 7.3.	Medium	The Observatory's two listed buildings are screened from view from the Proposed Development. The modern western fringe of the Observatory site has views of the Masterplan site and these contribute little to the buildings' significance. Restricted, narrow views along the access drive will largely be towards the thickened tree/planting screen in the north east corner of the site. The setting's contribution to the significance of the buildings will therefore be slightly affected	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge; • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings; • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road; • Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road.	Minor adverse	Negligible effect, as the building has no setting relationship with the development site.	Slight adverse **Not significant**
9 Wilberforce Road (1268352) Grade II listed. Two storey Modern Movement house built in 1937 by D. Cosens. The building is constructed from whitewashed brick laid in Flemish bond with a bituminous felt roof. Rectangular plan with a recessed corner section at south east corner.	Medium	The house is located opposite the Emmanuel College Sports Pitches, with the existing buildings on the Site visible beyond the trees lining Clerk Maxwell Road. As currently, the rooftops and taller elements of the Proposed Development will be visible, rising above the modern two storey housing in distant views to the west over the Emmanuel College sports pitches. However, the buildings will rise slightly higher than currently, slightly altering views from the asset.	• External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings; • At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45° angle to the parameter height of 31m AOD; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • Woodland infill planting at the site edges shall be native trees and shrubs and shall be in accordance with the Woodland Management Plan, Appendix 8.4, Volume 3; • Rooftop plant shall be set back from the predominant building line adjacent to Clerk Maxwell Road or effectively screened.	Minor Adverse	The University Buildings rising slightly higher above the two storey housing in views to the west than at present will result in permanent adverse effects to the setting of the house.	Slight Adverse **Not Significant**
Emmanuel College Sports Pavilion, including grounds man's house and stables (1422595) Grade II listed. Sports pavilion with attached Groundsman's House and separate stable, built for Emmanuel College in 1910. Complex roofscape of steep, sweeping pitches and hipped roof surmounted by a decorative copper cupola which has a polygonal base and a weathervane.	Medium	As currently, the rooftops and taller elements of the Proposed Development will be visible, rising above the modern two storey housing in distant views to the west over the Emmanuel College sports pitches. However, the buildings will rise slightly higher than currently, slightly altering views from the asset.		Minor Adverse	The University Buildings rising slightly higher above the two storey housing in views to the west than at present will result in permanent adverse effects to the setting of the pavilion and house.	Slight Adverse **Not Significant**

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Conduit Head Road Conservation Area See Section 7.3.	Medium	The presence of University buildings closer to Madingley Road than at present will impact on the views south along Conduit Head Road. However, the planting/tree screen along south side of Madingley Road will be thickened. In other respects, the screening to the south of the White House and the relative lack of sensitivity of the setting to the south and south west of the part of the Conservation Area to the east of the southern part of Conduit Head Road, means that the setting of the Conservation Area is quite robust. Also, the presence of university buildings on two sides of eth Conservation Area is part of its existing setting. There will therefore be a minor to moderate adverse change to the setting of the Conservation Area overall.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge. • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings. • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road; • Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road.	Minor-Moderate Adverse	Close views of the Proposed buildings from the southern end of the Conservation Area will be partly offset by the thickened planting/tree screen, but would result in permanent adverse effects to the setting of the Conservation Area.	Minor to Moderate Adverse **Significant Effect**

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
West Cambridge Conservation Area See Section 7.3.	Medium	The Proposed Development will not impact significantly on the Conservation Area's setting in relation to the Observatory Site. The existing presence of the university buildings along the western part of the Masterplan Site in the setting of Churchill College will be accentuated, although there will be improved planting/tree screening. There will be little impact on the significance of the built up area on the west edge of the Conservation Area south of Madingley Road and north of Emmanuel College Sports Ground, due to the minor contribution of setting here and the intimate nature of this area. In relation to Emmanuel College Sports Ground and the stretch of Wilberforce Road from the north side of the sports ground to the junction with Adams Road, the new buildings will rise slightly higher behind the modern housing in the setting of the Conservation Area. This will have a minor to moderate impact locally. In relation to the Conservation Area as a whole, the West Cambridge site currently makes very little contribution the significance of the Conservation Area, and overall there will be a minor adverse impact, although in relation to Emmanuel College Sports Ground and a stretch of Wilberforce road this will be slightly elevated locally to moderate adverse. The presence of university buildings of good quality is a positive element of the character of the Conservation Area in the Conservation Area Appraisal.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45° angle to the parameter height of 31m AOD; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge. • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Woodland infill planting at the site edges shall be native trees and shrubs and shall be in accordance with the Woodland Management Plan, Appendix 8.4, Volume 3; • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings.	Minor adverse overall	The university buildings will appear bulkier in the setting of the Conservation Area resulting in permanent adverse effects on its setting.	Minor Adverse **Not Significant**
Schlumberger Gould Research Centre See Section 4.3.	High	The Proposed Development will result in filing the site to the east of the building, as intended by Hopkins. However, the blocks around will remain lower than the listed building and the linear open space within the masterplan means that there will remain views from the west from within the site. The architectural significances of the building will remain unaltered by the development in its setting. Although the setting will be substantially altered the contribution of the setting to the building's significance will be largely retained, as it was always meant to be part of a campus, and was intended to be a feature building, which it will remain.	• The Listed Schlumberger Research building shall remain the primary landmark for the site. New development and spaces shall work together to define a new and appropriate setting for this building; • A view corridor with a minimum 20m width will be preserved between JJ Thomson Avenue and High Cross to protect views through the Site of the Schlumberger Research Building; • On the west side of High Cross, the Listed Schlumberger Research building shall remain visible as a key site landmark; • In the central part of High Cross Avenue, a zone of lower development height shall be established to maintain the views of the Schlumberger Research building roof structure. The exact positioning of this lower zone shall be such to allow views of the roof-line (tent structure) from The Green.	Minor to moderate adverse	The setting will be altered but its contribution to the building's significance will largely be retained, as it was meant to be part of a campus.	Moderate adverse **Significant Effect**

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7.5 Mitigation measures

Archaeology

7.5.1 Following the 2015 field evaluation for the Proposed Development a number of areas will require further fieldwork. These areas are discussed below.

Site 1 (Iron Age)

7.5.2 Site 1 has already been excavated having therefore already effectively been mitigated (see baseline section), it is only the area of Site 2 that will require full open-area excavation when development proceeds there. The further investigation of the Site 3 field system and trackway – aside from its incidental exposure in Site 2 – can, within Field 1, be limited to the area of new major building footprints and any further areas that will be disturbed through excavation, augmented by additional trenching.

Site 2 (Iron Age)

7.5.3 In addition to the written record produced during the 2015 field evaluation, a full open area excavation of Site 2 will be undertaken prior to construction works commencing. This will involve an area of not less than 1.2ha, with there being provision for a further 0.5ha expansion should the results warrant it

Site 3 (Iron Age/Roman)

7.5.4 Mitigation for Site 2 will further expose the field system which will be recorded. Additional trenching will be undertaken to establish the system's basic layout and, based on its results, it is anticipated that there will be up to 1ha of open-area excavation to further detail the system's layout, operations and date. This will be agreed with the County Council's Historic Environment Team (CHET).

Vicar's Farm

7.5.5 As confirmed by the 2011 Whittle Laboratory excavations (Slater 2011), the north western side of the Vicar's Farm Roman settlement extends into the eastern portion of that facility's grounds. This will require excavation over approximately 3,375m^2. Of this, excluding the 2011-area, approximately 2,100m^2 lie exterior to that building's footprint and will require full excavation prior to the Laboratory's demolition; occurring within the footprint-area, the excavation methods employed on the remaining portion (approximately1,275m^2) will be dependent upon the degree of preservation found following the Laboratory's demolition.

Nano Fabrication Building Site

7.5.6 A limited degree of Iron Age occupation evidence was found during the course of the 2001 investigations[20]. The settlement is likely to have extended across at least part of the area of the Cavendish Laboratory complex, but where it was unfeasible to cut any trial trenches during the 2015 evaluation programme. Accordingly, upon vacating the Laboratory buildings (but prior to their demolition), a limited trenching programme will be conducted within the grounds; should further evidence of early settlement be recovered (and dependent upon their degree of preservation), then an appropriate excavation programme will occur in conjunction with the demolition works. This will be agreed with CHET.

7.5.7 Dissemination and Post-Excavation – In conjunction with the excavations there will be a full programme of post-excavation, including site-by-site assessment reportage and, following analysis, appropriate publication of the results (as agreed with CHET); the archive, along with the finds, will be deposited in the County Council store. In terms of public outreach, regular fieldwork-update bulletins will be issued on the project's web-site and there will be a public open-day held at Site 2.

Built heritage

7.5.8 The following mitigation measures are specified in the Design Guidelines to minimise visual and setting impacts to built heritage receptors to the north and east of the Site:

- The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m;
- At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45° angle to the parameter height of 31m AOD;
- Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site;
- Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development;
- Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing;
- Treatment of façades shall be sensitive in scale and the use of materials;
- Woodland infill planting at the site edges shall be native trees and shrubs and shall be in accordance with the Woodland Management Plan, Appendix 8.4, Volume 3;
- The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3);
- Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge.
- Rooftop plant shall be set back from the predominant building line adjacent to Clerk Maxwell Road or effectively screened.
- External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings.
- The Listed Schlumberger Research building shall remain the primary landmark for the site. New development and spaces shall work together to define a new and appropriate setting for this building;
- A view corridor with a minimum 20m width will be preserved between JJ Thomson Avenue and High Cross to protect views through the Site of the Schlumberger Research Building;
- On the west side of High Cross, the Listed Schlumberger Research building shall remain visible as a key site landmark;

- In the central part of High Cross Avenue, a zone of lower development height shall be established to maintain the views of the Schlumberger Research building roof structure. The exact positioning of this lower zone shall be such to allow views of the roof-line (tent structure) from The Green.
- Rooftop plant shall not be located within the 32m AOD zone along Madingley Road;
- Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road;

7.6 Summary

7.6.1 During construction, the Proposed Development will have a significant adverse effect on the setting of the Schlumberger Gould Research Centre.

7.6.2 During operation, the Proposed Development will have a significant adverse effect on the White House, and the Schlumberger Gould Research Centre and Conduit Head Road Conservation Area. This does not constitute substantial harm as defined in the National Planning Policy Framework.

7.6.3 No significant effects would occur to Shawms, The Observatory, Northumberland Dome at the Observatory, 9 Wilberforce Road, Emmanuel College Sports Pavilion including groundsman's house and stables, or the West Cambridge Conservation Area.

8. Landscape and visual

8.1 Introduction

8.1.1 This chapter updates the landscape and visual assessment in the submitted ES to show the changes resulting from the amended Proposed Development. The landscape and visual assessment requires updating due to the reduced building heights specified in the parameter plans and new mitigation measures specified in the Design Guidelines. The following sections remain unchanged from the submitted ES and have not been replicated within this document.

- Scope of assessment;
- Relevant legislation and policy;
- Method of assessment;
- Baseline conditions.

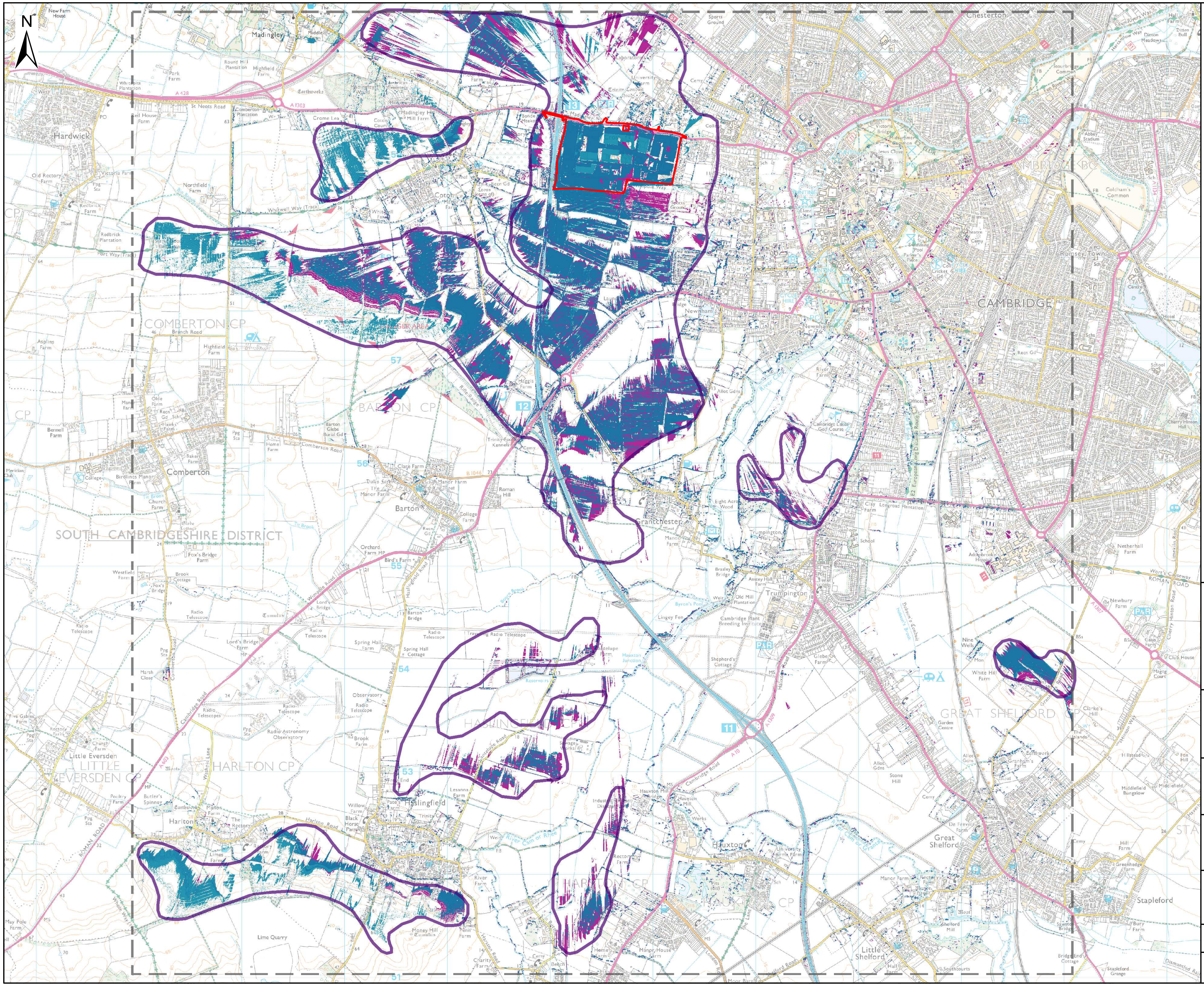
8.1.2 The following sections require updating to reflect the amended Proposed Development and are presented in this chapter:

- Impact assessment – Operational phase only. Construction phase effects remain unchanged;
- Mitigation measures;
- Summary.

8.2 Impact assessment

Operational phase

8.2.1 The operational phase assessment, considers the environment at year 1 and 15 following opening to assess the changes in effects associated with growth of the existing vegetation. Operational phase impacts are assessed in Tables 8.1 and 8.2. Visualisations of the parameter plans, which represent the maximum extent that buildings could be constructed to, from eight viewpoints are shown in Appendix 8.3, Volume 3. The revised Zone of Theoretical Visibility (ZTV) and visual envelope are shown on Figure 5.1.



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Site boundary

Extent of digital surface model (DSM) elevation data analysed

Visual envelope

Visible areas from proposed buildings

Visible areas from proposed buildings and 8m western flue

Notes:

The ZTV is an indication only of the area within which the the highest points of the proposed scheme buildings may be visible from ground level.

The study uses a 2 metre resolution Digital Surface Model (DSM), which takes into consideration the surface detail of vegetation and buildings.

0 0.5 1 Kilometre

Client Name: UNIVERSITY OF CAMBRIDGE

Licence Number: 100041040 2016

Digital Terrain/Surface Model - © Bluesky International Limited

Atkins Limited ©
Consulting Engineers
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Tel: +44(0)1454 662000
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www.atkinsglobal.com

Client

University of Cambridge

Project

West Cambridge Masterplan EIA

Title

Landscape
Zone of Theoretical Visibility
Figure 8.1

Sheet Size	Original Scale	Designed / Drawn	Checked	Authorised
A3	1:35,000	SJD	HM	DP
		Date 24/04/17	Date 24/04/17	Date 24/04/17

Drawing Number	Rev
5137998_CAM_LV_VIS	10

Path: P:\GBLOW\LEGE\PLH\Planning\Projects\5137998 West Cambridge Masterplan EIA\600 Working Folders\670 GIS\WIP\LV\5137998_CAM_LV_VIS_10_GEO095.mxd

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Table 8.1 Operational phase effects on landscape character areas

Baseline		Impact assessment				
Landscape character area	**Landscape sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
A – Cambridge Central Core	High	Some distant glimpsed views of the tops of new buildings, rooftop plant and the energy centre flue will be possible from elevated areas within the landscape character area.	None proposed	Opening year – Negligible Year 15 – Negligible	The distant glimpsed views from elevated areas such as the Great St Mary's Church tower of the tops of the new buildings, roof top plant, and the energy centre flue, will not affect the landscape character area which will retain its vibrant historic character. The landscape character area is outside the ZTV and the Proposed Development will not be perceptible from the open spaces. There will be no effect.	Opening year – Neutral **Not significant** Year 15 – Neutral **Not significant**
B – Chesterton / North Cambridge	Low	Some distant glimpsed views of the tops of new buildings, rooftop plant and the energy centre flue will be possible from elevated areas and western edge within the landscape character area.	None proposed	Opening year – Negligible Year 15 – Negligible	Distant glimpsed views of the new buildings, roof top plant, and the energy centre flue from elevated areas such as the Castle Mount will not affect the character of the landscape character area. The landscape character area is outside the ZTV and the Proposed Development will not be perceptible from the open spaces. There will be no effect.	Opening year – Neutral **Not significant** Year 15 – Neutral **Not significant**

Baseline		Impact assessment				
Landscape character area	**Landscape sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
C – West Cambridge Central Core	High	New buildings will be constructed close to the eastern boundary of the Site adjacent to the landscape character area, the building heights of these will be staggered with building heights reducing towards this character area.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Lengths of unbroken frontages on multi storey car parks shall be limited to 50m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • The development of continuous roof lines of consistent height along the key spaces, streets and Green Links shall be avoided and preference shall be given to compositions with varying roof lines and accents; • Development along the Southern Edge shall respond to long distance views. Long frontages here shall be broken/varied and additional tree planting and landscape shall be introduced to provide a softer, woodland edge; • Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD; • At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45° angle to the parameter height of 31m AOD; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location; • Large feature tree planting shall be provided at a minimum of 5 key locations along the Southern edge; • Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Long distance views shall be considered in the location of plant; • Plant should be considered as a way to add variation and interest in the roofscape; • Medium and large plant shall be considered as part of architectural concepts and building massing as an additional storey of the building. The roof plant will unavoidably be visible from public realm and so shall be treated with appropriate materials; • Visual impact of large plant areas shall be reduced by breaking their volume and providing variation in rooflines; • Any parts of building facade related to plant shall not be inferior to the rest of the facade in materials and treatment; • If larger flues are required, they shall be treated as part of the architectural concept design and placed in locations that don't overwhelm key open spaces; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south;	Opening year – Low adverse Year 15 – Low adverse	The western part of the landscape character area is within the ZTV and new buildings constructed up to the eastern boundary of the Site will be visible from some open areas such as the St John's College sports pitches. Elevated views from some tall buildings such as the University Library tower will experience new buildings which will give the sense of a denser form of urban development to the west of the landscape character area. As screening vegetation along the eastern boundary grows and matures together with existing screening vegetation, views of the new buildings will diminish. The staggered nature of these building heights will reduce the massing of the built forms adjacent to this character area. The proposed built form will still form prominent components. It is only the western portion of the landscape character area that will be affected. This will be a permanent adverse effect.	Opening year – Moderate adverse **Significant** Year 15 – Moderate adverse **Significant**

<table>
<tr><th colspan="2">Baseline</th><th colspan="5">Impact assessment</th></tr>
<tr><th>Landscape character area</th><th>Landscape sensitivity</th><th>Impact</th><th>Mitigation measure</th><th>Impact magnitude</th><th>Residual effect</th><th>Significance of effect</th></tr>
<tr><td>D – north west Cambridge</td><td>Low</td><td>Densification of the Site.
The energy centre flue could be visible from the landscape character area. From some limited areas, glimpsed views of some of the taller buildings may be possible.</td><td>The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m;
Lengths of unbroken frontages on multi storey car parks shall be limited to 50m;
Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials;
The development of continuous roof lines of consistent height along the key spaces, streets and Green Links shall be avoided and preference shall be given to compositions with varying roof lines and accents;
Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development;
Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing;
Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site;
The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development;
Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter;
Plant should be considered as a way to add variation and interest in the roofscape;
Medium and large plant shall be considered as part of architectural concepts and building massing as an additional storey of the building. The roof plant will unavoidably be visible from public realm and so shall be treated with appropriate materials;
Visual impact of large plant areas shall be reduced by breaking their volume and providing variation in rooflines;
Any parts of building facade related to plant shall not be inferior to the rest of the facade in materials and treatment;
If larger flues are required, they shall be treated as part of the architectural concept design and placed in locations that don't overwhelm key open spaces;
Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed;</td><td>Opening year – Low adverse
Year 15 – Negligible adverse</td><td>The denser urban development of the Site will result in an increase in urbanisation to the immediate south of the landscape character area which will reduce its 'city-edge character by removing the buffer to the open countryside to the south. Due to the contained nature of the landscape character area this is unlikely to be perceptible from within north west Cambridge.
Views of the energy centre flue will not adversely change the character of the landscape character area.
This will be a permanent adverse effect.</td><td>Opening year – Slight adverse
Not significant
Year 15 – Neutral
Not significant</td></tr>
</table>

Baseline		Impact assessment				
Landscape character area	**Landscape sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
E – Madingley	High	Densification of the Site. The tops of new buildings, roof top plant and the energy centre flue could all be visible from the landscape character area, the building heights along the western boundary will be staggered, reducing the proposed impact along the western boundary of the Proposed Development.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Lengths of unbroken frontages on multi storey car parks shall be limited to 50m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • The development of continuous roof lines of consistent height along the key spaces, streets and Green Links shall be avoided and preference shall be given to compositions with varying roof lines and accents; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Treatment of façades shall be sensitive in scale and the use of materials; • Materials for less visible façades shall be robust and designed to age well; • Large feature tree planting shall be provided at a minimum of 5 key locations within The Green public open space area, such as at the gateways to The Green or key nodes within the space; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Long distance views shall be considered in the location of plant; • Plant should be considered as a way to add variation and interest in the roofscape; • Medium and large plant shall be considered as part of architectural concepts and building massing as an additional storey of the building. The roof plant will unavoidably be visible from public realm and so shall be treated with appropriate materials; • Visual impact of large plant areas shall be reduced by breaking their volume and providing variation in rooflines; • Any parts of building facade related to plant shall not be inferior to the rest of the facade in materials and treatment; • If larger flues are required, they shall be treated as part of the architectural concept design and placed in locations that don't overwhelm key open spaces; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed;	Opening year – Low adverse Year 15 – Low adverse	The Proposed Development will result in an increase in urbanisation at the Site affecting the landscape character area to the west. The higher quality areas of the landscape character area are located between the Site, Coton, and Madingley and include a part of the Coton Countryside Reserve. These higher quality areas are visually contained and located outside of the ZTV. They are not tranquil due to traffic noise from the adjacent M11 and will not be affected by the Proposed Development. An area of open agricultural fields south of Madingley Road are less visually contained and are located within the ZTV. In this part of the landscape character area the Proposed Development will have an encroaching urbanising effect although this is partially offset by the M11 which acts as a barrier between the city and the landscape character area. The staggered nature of the building heights along the western boundary will slightly reduce the massing of the built forms. Screening vegetation along the M11 corridor is already established and unlikely to grow much taller. This will be a permanent adverse effect.	Opening year – Moderate adverse **Significant** Year 15 – Moderate adverse **Significant**

Baseline		Impact assessment				
Landscape character area	**Landscape sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
F – Coton	High	Densification of the Site. The new buildings, roof top plant and the energy centre flue will influence this landscape character area	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Lengths of unbroken frontages on multi storey car parks shall be limited to 50m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • The development of continuous roof lines of consistent height along the key spaces, streets and Green Links shall be avoided and preference shall be given to compositions with varying roof lines and accents; • Development along the Southern Edge shall respond to long distance views. Long frontages here shall be broken/varied and additional tree planting and landscape shall be introduced to provide a softer, woodland edge; • Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Treatment of façades shall be sensitive in scale and the use of materials; • Frontages facing the southern landscape shall have a high quality architectural treatment and materials; • Large feature tree planting shall be provided at a minimum of 5 key locations along the Southern edge. Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside. • Long distance views shall be considered in the location of plant; • Plant should be considered as a way to add variation and interest in the roofscape; • Medium and large plant shall be considered as part of architectural concepts and building massing as an additional storey of the building. The roof plant will unavoidably be visible from public realm and so shall be treated with appropriate materials; • Visual impact of large plant areas shall be reduced by breaking their volume and providing variation in rooflines; • Any parts of building facade related to plant shall not be inferior to the rest of the facade in materials and treatment; • If larger flues are required, they shall be treated as part of the architectural concept design and placed in locations that don't overwhelm key open spaces; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south;	Opening year – Medium adverse Year 15 – Medium adverse	The landscape character area has poor visual containment and much of it is within the ZTV. Red Meadow Hill, including parts of the Coton Countryside Reserve in particular, command clear and elevated views across and into the Site where the Proposed Development will be clearly visible. The staggered nature of the building heights along the southern boundary will slightly reduce the massing of the built forms however the Proposed Development will result in the encroachment of the city edge and increases the urbanising effect on this rural landscape character area although this is partially offset by the M11 which acts as a barrier between the city edge and the landscape character area. Screening vegetation along the M11 corridor is already established and unlikely to grow much taller. This will be a permanent adverse effect.	Opening year – Large adverse **Significant** Year 15 – Large adverse **Significant**

<table>
<tr><th colspan="2">Baseline</th><th colspan="5">Impact assessment</th></tr>
<tr><th>Landscape character area</th><th>Landscape sensitivity</th><th>Impact</th><th>Mitigation measure</th><th>Impact magnitude</th><th>Residual effect</th><th>Significance of effect</th></tr>
<tr><td>G – Grantchester</td><td>High</td><td>Densification of the Site.
The new buildings, roof top plant and the energy centre flue could all be visible from the landscape character area, the building heights along the southern boundary will be staggered reducing the proposed impact along this boundary.</td><td rowspan="2">• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m;
• Lengths of unbroken frontages on multi storey car parks shall be limited to 50m;
• Maximum build-to lines along High Cross Avenue shall be setback from the road corridor by at least 8m on the eastern side and by at least 5m on the western side of the street;
• At the southern end of High Cross Avenue, an additional frontage height restriction of 33m AOD (to the west) and 35m AOD (to the east) shall be applied. Any development above these heights shall be set back by a minimum of 5m from the primary frontage line;
• Building Zones along JJ Thompson Avenue are set to allow for a 10m buffer between the stems of the existing trees and the proposed building faces (maximum Build to Line);
• Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials;
• The development of continuous roof lines of consistent height along the key spaces, streets and Green Links shall be avoided and preference shall be given to compositions with varying roof lines and accents;
• Development along the Southern Edge shall respond to long distance views. Long frontages here shall be broken/varied and additional tree planting and landscape shall be introduced to provide a softer, woodland edge;
• Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD;
• Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development;
• Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing;
• Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting;
• Treatment of façades shall be sensitive in scale and the use of materials;
• Frontages facing the southern landscape shall have a high quality architectural treatment and materials;
• Large feature tree planting shall be provided at a minimum of 5 key locations along the Southern edge. Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter;
• Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside.
• Long distance views shall be considered in the location of plant;
• Plant should be considered as a way to add variation and interest in the roofscape;
• Medium and large plant shall be considered as part of architectural concepts and building massing as an additional storey of the building. The roof plant will unavoidably be visible from public realm and so shall be treated with appropriate materials;
• Visual impact of large plant areas shall be reduced by breaking their volume and providing variation in rooflines;
• Any parts of building facade related to plant shall not be inferior to the rest of the facade in materials and treatment;
• If larger flues are required, they shall be treated as part of the architectural concept design and placed in locations that don't overwhelm key open spaces;
• Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed;
• Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south;
• Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan.</td><td>Opening year – Medium adverse
Year 15 – Medium adverse</td><td>This landscape character area has a strong relationship with the Site and much of it is within the ZTV particularly the area north of Barton Road. South of Barton Road, blocks of woodland and hedgerows in addition to the increased distance result in a weaker relationship with the Site.
The staggered nature with the decreasing of the building heights towards the southern boundary will slightly reduce the massing of the built forms, however the Proposed Development will result in large institutional buildings continuing along the southern boundary. This will create an abrupt edge between the urban townscape and the open countryside resulting in an increased urbanising effect on this landscape character area. The line of buildings will be broken up by the tree planting along the green avenues running north-south through the Proposed Development and terminating at the west forum. With the staggered building heights and reinforcement of the screening planting associated with the Woodland Management Plan, including the legacy trees, along the southern boundary this will soften the effect once established
This will be a permanent adverse effect</td><td>Opening year – Large adverse
Significant
Year 15 – Large adverse
Significant</td></tr>
<tr><td>H – Haslingfield</td><td>High</td><td>Densification of the Site.
The new buildings, roof top plant and the energy centre flue could all be visible from the landscape character area, the building heights along the southern boundary will be staggered reducing the proposed impact along this boundary.</td><td>Opening year – Negligible
Year 15 – Negligible</td><td>The landscape character area has a weak relationship with the Site due to the large intervening distance between them. Other distinct landscape features including the travelling radio telescope blocks of woodland and communities such as Haslingfield exert a much greater influence on the character of the landscape character area than the Site. The southern edge of the Proposed Development will be visible in the distance from elevated areas in the landscape character area, such as Chapel Hill, on clear days but will not break the skyline and will be barely perceptible.
There will be no effect on the character of the landscape character area.</td><td>Opening year – Neutral
Not significant
Year 15 – Neutral
Not significant</td></tr>
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Baseline		Impact assessment				
Landscape character area	**Landscape sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
I – High Cross (Site of Proposed Development)	Low	The Proposed Development will increase the amount of built development on Site, particularly at the western end of the Site where undeveloped plots will become developed. There will be a large increase in occupants on the Site which will include commercial, academic service, maintenance staff, and students which will increase the vitality of the Site. Built development will be coherent with active frontages of high quality, integrated and publicly accessible open spaces, the proposals will also allow for staggered building heights across the Site particularly along boundaries and thoroughfares which will help to integrate the development into the wider landscape character. .	• Existing north-south streets shall be further greened through the use of development setbacks and landscaped areas formed alongside High Cross and Western Access/Ada Lovelace Road; • The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Lengths of unbroken frontages on multi storey car parks shall be limited to 50m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • The development of continuous roof lines of consistent height along the key spaces, streets and Green Links shall be avoided and preference shall be given to compositions with varying roof lines and accents; • The three north-south running streets and the Central Green Link shall have building to building width with a minimum of 30m; • Maximum build-to lines along High Cross Avenue shall be setback from the road corridor by at least 8m on the eastern side and by at least 5m on the western side of the street; • At the southern end of High Cross Avenue, an additional frontage height restriction of 33m AOD (to the west) and 35m AOD (to the east) shall be applied. Any development above these heights shall be set back by a minimum of 5m from the primary frontage line; • Building Zones along JJ Thompson Avenue are set to allow for a 10m buffer between the stems of the existing trees and the proposed building faces (maximum Build to Line); • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Treatment of façades shall be sensitive in scale and the use of materials; • Materials for less visible façades shall be robust and designed to age well; • Planting at the West Forum shall reinforce the visual connection from the upper areas to the wider landscape and the Southern Ecological Corridor; • Existing mature planting and hedgerows within the East Pond area and along the Southern edge shall be maintained with the appropriate tree buffer zone. New tree planting shall be accommodated within the East Pond space (to the north of the pond) to ensure that new development is set within landscape; • Large feature tree planting shall be provided at a minimum of 5 key locations within The Green public open space area, such as at the gateways to The Green or key nodes within the space. Where large trees are planted, they shall be given the proper environmental conditions and space to grow to maturity; • The impact of plant (and rooftop plant in particular) on building design and on open spaces shall be carefully considered from the concept stage of design; • Wherever possible, plant shall be placed on roofs in locations where it will not be visible from the public realm; • Any plant required to be provided as a separate structure shall not be located next to or within the key open spaces; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter. • Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan.	Opening year – low adverse Year 15 – low beneficial	There is a general lack of vitality of the Site particularly at the western half which has not yet been developed in accordance with the existing planning permission and is dominated by large empty plots and surface car parking. The Proposed Development, will transform the Site into a bustling and vibrant campus. The building design will be of high quality with staggered building heights along boundaries and tree planting along the green avenues running north-south. Active frontages will face onto integrated publicly accessible open spaces. New planting associated with the landscape design will be immature at the opening year which will result in hardscaped areas and new built form giving rise to a starker character than at present. This will be a temporary adverse effect. As the planting associated with the landscape design and Woodland Management Plan matures, the hardscaped areas and built form will soften and better reflect the surrounding leafy peri-urban environment. This will be a permanent beneficial effect.	Opening year – Slight adverse **Not significant** Year 15 – Slight beneficial **Not significant**

Table 8.2 Operational phase effects on visual receptors

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 1 Public viewpoint within the Coton Countryside Reserve	High	The Proposed Development would form a prominent consolidated alignment to the settlement edge with infill development within the existing view of the Site. This view is a key viewpoint that is highlighted in the Cambridge Skyline document and, as a result of its geography, will result in a change to visual perception of the users. External lighting and lighting from windows would contribute to sky glow.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • The development of continuous roof lines of consistent height along the key spaces, streets and Green Links shall be avoided and preference shall be given to compositions with varying roof lines and accents; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Large feature tree planting shall be provided at a minimum of 5 key locations along the Southern edge. • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Long distance views shall be considered in the location of plant; • Plant should be considered as a way to add variation and interest in the roofscape; • Any parts of building facade related to plant shall not be inferior to the rest of the facade in materials and treatment; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application.	Opening year – High adverse Year 15 – High adverse	Views from the elevated vantage point will look into the Proposed Development this will be seen with the historic city core in the background. The Proposed Development would include the introduction of new built forms within an existing view that contains a mixture of built forms seen from a medium distance. The buildings with the greatest proposed visual impact would be located on the south western and southern portion of the Site, these would help to mitigate the views of proposed buildings further to the north and east. The proposed building heights and massing will create a change of view from this receptor increasing the visible built forms and extend the urbanisation of the settlement edge towards the viewpoint. Light spill/sky glow will impact upon visual amenity of the receptor particularly seen within the foreground of the wider city skyline. Mitigating the control of lighting, in particular the spread to surrounding areas, will help to reduce the impact at night. Through the use of vegetation and building treatments the longer term effects will be reduced. This would be a permanent adverse effect.	Opening year – Large adverse **Significant** Year 15 – Large adverse **Significant**

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 2 Public Right of Way alongside the western boundary (39/30) and adjacent to the M11.	Medium	The Proposed Development would result in new buildings close to the western boundary adjacent to the public right of way. External lighting and lighting from windows on the western facades of the buildings would result in light spill and contribute to sky glow.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Any new landscaped gaps between buildings along the western edge shall be a minimum of 20m from building face to building face. • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application.	Opening year – Low adverse Year 15 – Low adverse	Due to the presence of a thick dense belt of vegetation along the western boundary, there is only a single view into the Site from the public right of way through a gap which coincides with an overhead power line. The Proposed Development would include the introduction of new built forms into part of the existing view. The proposed buildings will intensify the present development along the western edge of the Site, the building heights will be staggered with lower built form/heights along the western boundary. The result will be a change to the existing view. Light spill/sky glow will impact upon the visual amenity of the receptor. Mitigating the control of lighting particularly any light spill from the Site onto the public right of way will reduce the effects at night. Through the use of additional vegetation and building treatments/heights the longer term effects will be reduced. This would be a permanent adverse effect.	Opening year – Slight adverse **Not significant** Year 15 – Slight adverse **Not significant**

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 3 Harcamlow Way (39/31a)	Medium	The Proposed Development would result in new buildings close to the southern boundary of the Site adjacent to the public right of way. External lighting and lighting from windows on the southern facades of the buildings would result in light spill and contribute to sky glow	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location. • Planting at the West Forum shall reinforce the visual connection from the upper areas to the wider landscape and the Southern Ecological Corridor; • Existing mature planting and hedgerows within the East Pond area and along the Southern edge shall be maintained with the appropriate tree buffer zone. New tree planting shall be accommodated within the East Pond space (to the north of the pond) to ensure that new development is set within landscape; • Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application; • Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan.	Opening year – High adverse Year 15 – Medium adverse	The Proposed Development would introduce new buildings along the southern boundary adjacent to the public right of way resulting in short distance views of the new built forms. This will create a change of view from this receptor increasing the feeling of urbanisation. Light spill/sky glow will impact upon the visual amenity of the receptor. Mitigating the control of lighting particularly any light spill from the Site onto the public right of way will reduce the effects at night. Reinforcing the existing screening vegetation and setting back buildings together with creating staggered building heights with reducing heights towards the southern boundary would help to reduce the impact on views. The effects would reduce over time as new planting associated with the Woodland Management Plan matures and establishes. This would be a permanent adverse effect.	Opening year – Moderate adverse **Significant** Year 15 – Slight adverse **Not significant**

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 4 Wimpole Way (39/31a)	Medium	The Proposed Development would result in new buildings close to the southern boundary of the Site adjacent to the public right of way. External lighting and lighting from windows on the southern facades of the buildings would result in light spill and contribute to sky glow	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location. • Planting at the West Forum shall reinforce the visual connection from the upper areas to the wider landscape and the Southern Ecological Corridor; • Existing mature planting and hedgerows within the East Pond area and along the Southern edge shall be maintained with the appropriate tree buffer zone. New tree planting shall be accommodated within the East Pond space (to the north of the pond) to ensure that new development is set within landscape; • Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application; • Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan.	Opening year – Medium adverse Year 15 – Low adverse	The Proposed Development would introduce new buildings along the southern boundary adjacent to the public right of way resulting in short distance views of the new built form. Views into the Site will open up via the new East Forum but the quality of the current views, which include the dated existing Cavendish Laboratories, will be improved through better quality landscape design and new buildings with high architectural finishes. This will create a change of view from this receptor increasing the feeling of urbanisation. Light spill/sky glow will impact upon the visual amenity of the receptor. Mitigating the control of lighting particularly any light spill from the Site onto the public right of way will reduce the effects at night. Reinforcing the existing screening vegetation and setting back buildings together with creating staggered building heights with lower heights towards the southern boundary would help to soften views. The effects would lessen over time as new planting associated with the Woodland Management Plan matures and establishes. This would be a permanent adverse effect.	Opening year – Moderate adverse **Significant** Year 15 – Slight adverse **Not significant**

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 5 Clerk Maxwell Road	High	The Proposed Development would result in new buildings close to the eastern boundary of the Site adjacent to the public right of way. External lighting and lighting from windows on the eastern facades of the buildings would result in light spill and contribute to sky glow	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45° angle to the parameter height of 31m AOD; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Rooftop plant shall be set back from the predominant building line adjacent to Clerk Maxwell Road or effectively screened. • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application; • Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan.	Opening year – Low adverse Year 15 – Negligible adverse	Views of the Site from residential receptors off Clerk Maxwell Road at the Lawns and Perry Court are extremely limited due to the presence of thick belts of screening vegetation on either side of the road. Views of the new built forms would only be from upper storey windows. The Proposed Development would result in new buildings being constructed closer to the eastern boundary of the Site, these will have a staggered roof height with the lower ones towards the eastern boundary. The existing screening vegetation and the proposed mitigation would ensure that changes to views from the residential properties are limited to glimpses of roof tops, at the year of opening. As the existing screening vegetation and new vegetation associated with the Woodland Management Plan matures, views of the new built form will reduce further. Light spill could result from the new buildings onto Clerk Maxwell Road. Mitigation to control light spill from external lighting will reduce effects on the views of residential receptors at night time. This would be a permanent adverse effect.	Opening year – Moderate adverse **Significant** Year 15 – Neutral **Not Significant**
Viewpoint 6 Wilberforce Road	High	The Proposed Development would result in new buildings close to the eastern boundary of the Site. External lighting and lighting from windows would contribute to sky glow		Opening year – Medium adverse Year 15 – Medium adverse	The Proposed Development would introduce new built forms up to the eastern boundary of the Site. Residents of properties along Wilberforce Road, opposite the Emmanuel College Recreation Ground, would experience this new built form in views that contain a contrasting scale of built forms with open space and residential buildings in the foreground and the new taller buildings beyond. These will have a staggered roof height with the lower buildings located towards the eastern boundary, which would have the effect of reducing the massing of the built form adjacent to the residential edge. The existing screening vegetation and new planting associated with the Woodland Management Plan would ensure that changes to views from the residential properties are limited to glimpses of the upper storeys and rooftops, at the year of opening, between gaps in the existing mature screening vegetation. As the screening vegetation further matures views of the new built form will reduce further. Mitigation to control light spill from external lighting will reduce the effects of sky glow on the views of residential receptors at night time. This would be a permanent adverse effect.	Opening year – Moderate adverse **Significant** Year 15 – Moderate adverse **Significant**

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 7 Dane Drive	High	The Proposed Development would result in new buildings close to the southern boundary of the Site. External lighting and lighting from windows would contribute to sky glow	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location. • Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Where service areas, multi storey car parks and development ‘backs’ are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application; • Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan.	Opening year – Medium adverse Year 15 – Medium adverse	The Proposed Development would introduce new built forms into a view that contains open space in the foreground and a mixture of existing built forms concentrated at the southern and south eastern portion of the Site. Residents would have glimpsed views of the Proposed Development from rearward facing windows in the upper storeys of their houses. The new buildings along the southern boundary will intensify the level of development with increased massing. This would be offset by lower building heights along the southern boundary which will change the view from these residential receptors. Mitigation to control light spill from external lighting will reduce the effects of sky glow on the views from the viewpoint at night time. Through the use of planting associated with the Woodland Management Plan and building treatments, the longer term effects will be reduced. This would be a permanent adverse effect.	Opening year – Large adverse **Significant** Year 15 – Large adverse **Significant**

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 8 and 9 Conduit Head Road and Madingley Road	High	The Proposed Development would result in new buildings close to the northern and eastern boundaries of the Site. External lighting and lighting from windows would contribute to sky glow	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Large feature tree planting shall be incorporated at key locations along High Cross, such as: the gateway to Madingley Road and the interface with The Green; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge; • Large feature tree planting shall be incorporated at key spaces along JJ Thompson Avenue such as the gateway to Madingley Road and the interface with The Green; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road; • Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application.	Opening year – Medium adverse Year 15 – Medium adverse	The Proposed Development would result in new buildings along the northern and eastern boundaries of the Site adjacent to Madingley Road. The new buildings will result in a substantial change in views from this receptor increasing the feeling of urbanisation. The building lines would be brought closer to the road corridor, although the building heights are proposed to be staggered the effect will be to increase the urbanisation effect. Mitigation to control light spill from external lighting will reduce the effects of sky glow on the views from the residential receptors at night time. With the maturing of the existing tree planting and new planting associated with the Woodland Management Plan and along the green avenues this would reduce the longer term effects. This would be a permanent adverse effect.	Opening year – Large adverse **Significant** Year 15 – Large adverse **Significant**

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 10 Public Right of Way to the south of Harcamlow Way (55/9)	Medium	The Proposed Development would result in new buildings close to the southern boundary of the Site. External lighting and lighting from windows would contribute to sky glow	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD; • The three north-south running streets and the Central Green Link shall have building to building width with a minimum of 30m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location. • Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application; • Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan.	Opening year – High adverse Year 15 – Medium adverse	The Proposed Development would introduce new built forms into a view that contains open agricultural fields in the foreground and a mixture of existing built forms concentrated at the south eastern portion of the Site. The new buildings along the southern boundary will intensify development with increased massing resulting in an abrupt urban edge that will change the view from this receptor particularly as it is viewed from a mid-distance. The built forms will have a staggered roof line with the lower buildings along the southern boundary, this would add a variety to the built forms reducing the intensification. Mitigation to control light spill from external lighting will reduce the effects of sky glow on the views from the viewpoint at night time. Through the use of vegetation, associated with the Woodland Management Plan, and building treatments, the longer term effects will be reduced. This would be a permanent adverse effect.	Opening year – Moderate adverse **Significant** Year 15 – Moderate adverse **Significant**
Viewpoint 11 Madingley Road (West)	Low	The Proposed Development would result in new buildings close to the northern and eastern boundaries of the Site. External lighting and lighting from windows would contribute to sky glow	None proposed	Opening year – Negligible Year 15 – Negligible	Views of the Site from Madingley Road, west of the M11, are completely screened by the intervening vegetation along the southern boundary of Madingley Road and the blocks of woodland on east and western boundaries of the M11. There would be no effect.	Opening year – Neutral **Not Significant** Year 15 – Neutral **Not significant**

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 12 Madingley Road (East)	Medium	The Proposed Development would result in new buildings close to the northern boundary of the Site along Madingley Road. External lighting and lighting from windows would contribute to sky glow	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Large feature tree planting shall be incorporated at key locations along High Cross, such as: the gateway to Madingley Road and the interface with The Green; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road; • Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application.	Opening year – High adverse Year 15 – High adverse	The Proposed Development will increase the proximity of built form to the northern boundary of the Site adjacent to Madingley Road which would increase the scale and presence of the built forms along the western Cambridge approach. The new buildings will result in a substantial change in views from this receptor. This will increase the feeling of urbanisation to the settlement edge and gateway to Cambridge. Light spill could result from the new buildings onto Madingley Road. Mitigation to control light spill from external lighting will reduce effects on the views of travellers at night time. The effects of the building scale impacts will be reduced as the tree planting along the north-south green avenues mature. This would be a permanent adverse effect.	Opening year – Moderate adverse **Significant** Year 15 – Moderate adverse **Significant**

<table>
<tr><th colspan="2">Baseline</th><th colspan="5">Impact assessment</th></tr>
<tr><th>Visual receptor</th><th>Sensitivity</th><th>Impact</th><th>Mitigation measure</th><th>Impact magnitude</th><th>Residual effect</th><th>Significance of effect</th></tr>
<tr>
<td>Viewpoint 13
Public Right of Way crossing M11 Motorway (55/6)</td>
<td>Medium</td>
<td>The Proposed Development would result in the introduction of new buildings close to the southern boundary of the Site.
External lighting and lighting from windows would contribute to sky glow</td>
<td rowspan="2">• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m;
• Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD;
• The three north-south running streets and the Central Green Link shall have building to building width with a minimum of 30m;
• Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials;
• Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development;
• Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing;
• Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site;
• Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location.
• Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside;
• Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting;
• Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed;
• Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter;
• Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south;
• Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone;
• An artificial lighting scheme shall be submitted with each reserved matters application;
• Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan.</td>
<td>Opening year – Medium adverse
Year 15 – Medium adverse</td>
<td>The Proposed Development will result in new buildings along the southern boundary which will change the views from the elevated pedestrian footbridge crossing the M11. This will result in an urbanising effect on the views and the existing Schlumberger Gould Research Centre would be screened by the intervening buildings and will no longer feature in the views. This will have an increased urbanising effect on the views of West Cambridge.
Views of the Proposed Development along the M11 will be limited to glimpses from specific locations where there are gaps in the vegetation and the M11 is not in cutting. Views will be limited to northbound traffic.
Mitigation to control light spill from external lighting will reduce the effects of sky glow on the views at night time. The built forms will have a staggered roof line with the lower buildings along the southern boundary, this would add a variety to the built forms reducing the intensification.
Through the use of vegetation, associated with the Woodland Management Plan, and building treatments the longer term effects of urbanisation will be reduced.
This would be a permanent adverse effect.</td>
<td>Opening year – Slight adverse
Not significant
Year 15 – Slight adverse
Not significant</td>
</tr>
<tr>
<td>Viewpoint 14
Public Right of Way to the west of Laundry Farm (55/6)</td>
<td>Medium</td>
<td>The Proposed Development would result in the introduction of new buildings close to the southern boundary of the Site.
External lighting and lighting from windows would contribute to sky glow</td>
<td>Opening year – Medium adverse
Year 15 – Medium adverse</td>
<td>Medium distance views of the Proposed Development will be possible from the public right of way where new buildings extend above the intervening hedgerows and screening vegetation. The Proposed Development would introduce new built forms into a view that contains open agricultural fields in the foreground and a mixture of existing built forms concentrated at the south eastern portion of the Site.
The new buildings along the southern boundary will create a change of view from this receptor that will result in an abrupt edge to the Site and an urbanising effect to the view.
Building treatments, limits on plot size together with the built forms and staggered roof heights, with the lower buildings along the southern boundary would add a variety to the built forms while minimising the urbanising effects.
Mitigating to control light spill, in particular the spread to surrounding open landscape to the south of the Site, would reduce the impact upon the visual amenity of the receptor particularly when seen against the skyline at night.
Reinforcement of the existing screening vegetation, controlled through the Woodland Management Plan, along the southern boundary will provide some transition to an abrupt change in character along this south settlement edge. The effects will reduce overtime as the new planting matures.
This would be a permanent adverse effect.</td>
<td>Opening year – Moderate adverse
Significant
Year 15 – Slight adverse
Not significant</td>
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<tr><td>Viewpoint 15
Grantchester Road</td><td>Low</td><td>The Proposed Development would result in the introduction of new buildings close to the southern boundary of the Site.
External lighting and lighting from windows would contribute to sky glow</td><td rowspan="2">• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m;
• Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD;
• The three north-south running streets and the Central Green Link shall have building to building width with a minimum of 30m;
• Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials;
• Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development;
• Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing;
• Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site;
• Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location.
• Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside;
• Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting;
• Where service areas, multi storey car parks and development ‘backs’ are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed;
• Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter;
• Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south;
• Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone;
• An artificial lighting scheme shall be submitted with each reserved matters application;
• Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan.</td><td>Opening year – Low adverse
Year 15 – Low adverse</td><td>Medium distance glimpsed views of the Proposed Development will be possible from the elevated approach to the M11 overbridge. The Proposed Development would introduce new built forms into a view that contains the M11 and open agricultural fields in the foreground and a mixture of existing built forms concentrated at the south eastern portion of the Site.
Views of the new buildings will be limited to the upper storeys of the southern and western facades and rooftops, which extend above the screening vegetation and the intervening M11, resulting in an urbanising effect.
Mitigating to control light spill, in particular the spread to surrounding open landscape to the south of the Site, would reduce the impact upon the visual amenity of the receptor particularly when seen against the skyline at night.
Building treatments and limits on plot size together with the staggered roof line, with the lower buildings along the southern boundary, would add a variety to the built forms which will minimise the urbanising effects.
Reinforcement of the existing screening vegetation, controlled through the Woodland Management Plan, along the southern boundary will provide some transition to an abrupt change in character along this south settlement edge. The effects will reduce overtime as the new planting matures.
This would be a permanent adverse effect.</td><td>Opening year – Slight adverse
Not Significant
Year 15 – Slight adverse
Not significant</td></tr>
<tr><td>Viewpoint 16
Barton Road</td><td>Medium</td><td>The Proposed Development would result in the introduction of new buildings close to the southern boundary of the Site.
External lighting and lighting from windows would contribute to sky glow.</td><td>Opening year – Medium adverse
Year 15 – Medium adverse</td><td>A dense block of woodland along the northern boundary of Barton Road limits views of the Proposed Development to a short section of the road just north of the roundabout junction with Grantchester Road and Coton Road. Here longer distance glimpsed views of the Proposed Development will be possible.
The introduction of the proposed buildings would increase the existing massing of built forms within this view. The built forms will have a staggered roof line with the lower buildings along the southern boundary, this would add a variety to the built forms reducing the intensification.
After 15 years the strengthened boundary planting, associated with the Woodland Management Plan, will begin to mature and intervening vegetation, between the viewpoint and the Proposed Development, will develop to soften views.
External lighting could result in an increase in sky glow but mitigation will minimise the effect and is unlikely to be perceptible from this distance.
This would be a permanent adverse effect.</td><td>Opening year – Moderate adverse
Significant
Year 15 – Slight adverse
Not significant</td></tr>
<tr><td>Viewpoint 17
Cambridge Rugby Football Club</td><td>Low</td><td>The Proposed Development would result in new buildings close to the southern boundary of the Site.
External lighting and lighting from windows would contribute to sky glow</td><td>None proposed</td><td>Opening year – Negligible
Year 15 – Negligible</td><td>There is substantial mature vegetation and some existing built form between the viewpoint and the Proposed Development which effectively screens views northwards. The viewpoint is outside of the ZTV and views from the rugby club would not feature the Proposed Development.
External lighting could result in an increase in sky glow but mitigation will minimise the effect and is unlikely to be perceptible due to the existing intervening development.
There would be no effect.</td><td>Opening year – Neutral
Not significant
Year 15 – Neutral
Not significant</td></tr>
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Baseline		**Impact assessment**				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 18 Coton Road	Medium	The Proposed Development would result in new buildings close to the southern boundary of the Site. External lighting and lighting from windows would contribute to sky glow	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD; • The three north-south running streets and the Central Green Link shall have building to building width with a minimum of 30m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location. • Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application.	Opening year – Medium adverse Year 15 – Medium adverse	The Proposed Development would introduce new built forms into an existing long distance view. The blocks of woodland, north and south, of Grantchester Road would limit views of the Proposed Development to the upper storeys and rooftops of the new buildings and the new energy centre flue which would form new features on the skyline. This would have an urbanising effect and give the impression of a westward extension of the city. Mitigating to control light spill, in particular the spread to surrounding open landscape to the south of the Site, would reduce the impact upon the visual amenity of the receptor particularly when seen against the skyline at night. Building treatments and limits on plot size, along with the introduction of a few legacy trees along the southern boundary, will minimise the urbanising effects. This would be a permanent adverse effect.	Opening year – Slight adverse **Not significant** Year 15 – Slight adverse **Not significant**
Viewpoint 19 Public Right of Way south west of Grantchester (106/6)	Medium	The Proposed Development would result in new buildings close to the southern boundary of the Site. External lighting and lighting from windows would contribute to sky glow	None proposed	Opening year – Negligible Year 15 – Negligible	Most of this public right of way will not afford views of the Proposed Development due to the intervening vegetation comprising blocks of woodland, groups and individual trees and hedgerows along field boundaries. A short section of the public right of way near Grantchester will experience glimpsed long distance views of the energy centre flue. These will not be prominent features within the view. Mitigation to prevent light spill, in particular the spread to surrounding open landscape to the south of the Site, would minimise sky glow. This is unlikely to be perceptible over the long distance. There would be no effect.	Opening year – Neutral **Not Significant** Year 15 – Neutral **Not Significant**

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 20 Public Right of Way west of Grantchester (106/5)	Medium	The Proposed Development would result in new buildings close to the southern boundary of the Site. External lighting and lighting from windows would contribute to sky glow	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD; • The three north-south running streets and the Central Green Link shall have building to building width with a minimum of 30m; • Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location. • Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside; • Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting; • Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed; • Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application.	Opening year – Low adverse Year 15 – Low adverse	The Proposed Development will result in new buildings along the southern boundary. The upper storeys and rooftops of these new buildings and the energy centre flue will be visible from this footpath. Due to the long intervening distance this will result in a minor change in views from this receptor which will result in a slight urbanising effect. Limits on building massing along the southern boundary and building treatments, along with the introduction of a few legacy trees along the southern boundary, will minimise the urbanising effect. Mitigation to prevent light spill, in particular the spread to surrounding open landscape to the south of the Site, would minimise sky glow. This is unlikely to be perceptible over the long distance. This would be a permanent adverse effect.	Opening year – Slight adverse **Not Significant** Year 15 – Slight adverse **Not Significant**
Viewpoint 21 Public Right of Way along the top of Chapel Hill (117/15)	Medium	The Proposed Development would result in new buildings close to the southern boundary of the Site. External lighting and lighting from windows would contribute to sky glow	None proposed	Opening year – Negligible Year 15 – Negligible	The viewpoint has long distance views from the elevated vantage point looking across the landscape with the Proposed Development in the distance. New buildings along the southern boundary will be seen as part of a wider view with Cambridge City in the background. The Proposed Development would form a visible element within the existing view of the wider Cambridge conurbation resulting in an urbanisation effect. Due to the long intervening distance the Proposed Development will result in a minor change in a small proportion of the overall view from this receptor. Mitigation to prevent light spill, in particular the spread to surrounding open landscape to the south of the Site, would minimise sky glow. This is unlikely to be perceptible over the long distance. There would be no effect	Opening year – Neutral **Not Significant** Year 15 – Neutral **Not Significant**

Baseline		Impact assessment				
Visual receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Viewpoint 22 Chapel Hill	Low	The Proposed Development would result in new buildings close to the southern boundary of the Site. External lighting and lighting from windows would contribute to sky glow	None proposed	Opening year – Negligible Year 15 – Negligible	The viewpoint has long distance views from the elevated vantage point looking across the landscape with the Proposed Development in the distance. New buildings along the southern boundary will be seen as part of a wider view with Cambridge City in the background. The Proposed Development would form a visible element within the existing view of the wider Cambridge conurbation resulting in an urbanisation effect. Due to the long intervening distance the Proposed Development will result in a minor change in a small proportion of the overall view from this receptor. Mitigation to prevent light spill, in particular the spread to surrounding open landscape to the south of the Site, would minimise sky glow. This is unlikely to be perceptible over the long distance. There would be no effect	Opening year – Neutral **Not Significant** Year 15 – Neutral **Not Significant**
Viewpoint 23 Castle Mound	Medium	The Proposed Development would result in new buildings infilling the Site. External lighting and lighting from windows would contribute to sky glow	• Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter; • Long distance views shall be considered in the location of plant; • Plant should be considered as a way to add variation and interest in the roofscape; • Medium and large plant shall be considered as part of architectural concepts and building massing as an additional storey of the building. The roof plant will unavoidably be visible from public realm and so shall be treated with appropriate materials; • Visual impact of large plant areas shall be reduced by breaking their volume and providing variation in rooflines; • Any parts of building facade related to plant shall not be inferior to the rest of the facade in materials and treatment; • If larger flues are required, they shall be treated as part of the architectural concept design and placed in locations that don't overwhelm key open spaces; • Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone; • An artificial lighting scheme shall be submitted with each reserved matters application.	Opening year – Low adverse Year 15 – Low adverse	The Castel Mount will have medium distance views of the Proposed Development, from an elevated location, between gaps in the intervening vegetation and built form. Only the very tops of some of the buildings and the energy centre flue will be glimpsed resulting in a minor change in views from this receptor. The viewpoint is located close to the city centre and is surrounded by external artificial lighting. Sky glow from the Proposed Development would not be perceptible. This would be a permanent adverse effect.	Opening year – Slight adverse **Not significant** Year 15 – Slight adverse **Not significant**

8.3 Mitigation measures

8.3.1 Relevant planning policy and supplementary guidance for Cambridge have informed the environmental design as an integral part of the Proposed Development. Key considerations include important views, landscape character and the quality of the setting of Cambridge as well as the landscape constraints identified as part of the baseline desk study, survey and consultation. The objective is to protect and enhance the intrinsic character of the local landscape with reference to key characteristics and features which help inform the siting, massing, design and materials of the Proposed Development.

8.3.2 Design principles based on relevant planning policy and supplementary guidance to minimise the impact on landscape character views and visual amenity include:

- Maximising the positive aspects of the Proposed Development and its surroundings through creative design and use of local materials, including native planting in order to enhance the local sense of place and adjacent rural landscape character, with emphasis on environmental quality and sustainability;
- Identifying the existing features, habitats and planting for retention and protection;
- Designing the scale, massing and layout, and arrangement of features and finishes, to integrate the Proposed Development into the grain of the urban edge including adjacent landscape character areas of the north west Cambridge site and adjacent Green Belt and reduce visibility of the Proposed Development in views across the area;
- Creating opportunities to improve landscape character of the Proposed Development on the urban edge through an integrated approach to mitigation improving biodiversity, connectivity and amenity of the urban edge is improved;
- Providing adequate land for tree planting where possible within and along the boundaries so the Proposed Development can be successful integrated into the wider rural landscape and provides a 'soft green edge to the City';
- Carefully consider the location and design of lighting, in relation to the Institution of Lighting Engineers guidance, to minimise light spill into the surrounding Green Belt;
- Selecting a palette of building finishes, including the choice of colour and materials, and planting types and species which is sympathetic to the setting of the Site; and
- Implementing a landscape management plan to ensure the maintenance of existing features and the establishment of the new planting and the management of replacement habitats, including those features which are specifically aimed at providing ecological mitigation.

8.3.3 Based on these principles specific mitigation measures have been identified for the construction and operational phases which will avoid or reduce the identified significant effects.

Construction phase

8.3.4 During construction the following mitigation measures will be implemented. This will be achieved by specifying these measures in the Construction Environmental Management Plan.

- Vegetation on Site to be retained will be protected from accidental damage during construction by erecting temporary fencing;
- Temporary hoarding will be used around all construction compounds and work sites to screen views of construction activities;
- The use of security lighting during construction will be minimised. Where it is needed Institute of Lighting Engineers guidance[3] will be followed to minimise light spill;
- Construction traffic to and from the Site will travel along haul routes agreed with Cambridgeshire County Council. The haul routes will avoid Cambridge city centre and Madingley Road west of the M11, where possible;
- Mitigation measures to minimise construction noise will help to preserve the tranquil character of the adjacent landscape character areas; and
- Operation of a clean and tidy construction site, including the covering of stockpiles.

Operational phase

8.3.5 As discussed in Chapter 4 (Alternatives) the parameter plans have been amended to minimise the impact of building mass on the views and the surrounding landscape character areas. This has been achieved by reducing the overall heights of the buildings across the Site and by stepping building heights so that buildings adjacent to the Site boundaries are lower than buildings in the centre of the Site.

8.3.6 In addition the following design measures are included in the Design Guidelines to minimise the effects of the Proposed Development on specific viewpoints and landscape character areas:

- Existing north-south streets will be further greened through the use of development setbacks and landscaped areas formed alongside High Cross and Western Access/Ada Lovelace Road;
- The maximum length of an uninterrupted building frontage and/or roof line will not exceed 50m – The frontages longer than 50m shall employ at least one of the strategies described in Figure 24 of the Design Guidelines for breaking the long frontages. The choice of one or more of the strategies will depend on the location on the site: some strategies will be better suited for the site edges (for example using planting adjacent to woodland buffers) others will be required along streets or key spaces (for example varying roof lines and building lines);
- Lengths of unbroken frontages on multi storey car parks will be limited to 50m – Frontage lengths of multi storey car parks longer than 50m shall be broken by introducing one or more of the strategies and/or other measures described in Figure 25 of the Design Guidelines, which achieve the effect of introducing variety and breaking down the frontage length;
- Maximum build-to lines along High Cross Avenue will be setback from the road corridor by at least 8m on the eastern side and by at least 5m on the western side of the street – Thus, together with the road corridor of 25.3m, the width between buildings along High Cross shall be a minimum 38.3m in the south and 44.8m minimum in the north;
- At the southern end of High Cross Avenue, an additional frontage height restriction of 33m AOD (to the west) and 35m AOD (to the east) will be applied. Any development above these heights will be set back by a minimum of 5m from the primary frontage line;

[3] Institute of Lighting Engineers, 2011, Guidance notes for the reduction of obtrusive light GN01:2011

- Building Zones along JJ Thompson Avenue are set to allow for a 10m buffer between the stems of the existing trees and the proposed building faces (maximum Build to Line) – This provides an additional zone of minimum 4m between the edge of the road corridor and the building faces on each side. Thus, together with the road corridor width of 25.3m, the width between buildings along JJ Thomson Avenue shall be minimum 33.3m;
- Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site;
- Frontages facing the southern landscape will have a high quality architectural treatment and materials. Materials and facade design will respond to this south facing location.
- Primary frontages will be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials;
- The development of continuous roof lines of consistent height along the key spaces, streets and Green Links will be avoided and preference will be given to compositions with varying roof lines and accents;
- Development along the Southern Edge will respond to long distance views. Long frontages here will be broken/varied and additional tree planting and landscape will be introduced to provide a softer, woodland edge;
- Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary will not exceed 31m AOD;
- At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form will comply with an additional height restriction of 25m AOD. From this line, the development heights will remain within envelope rising by 45° angle to the parameter height of 31m AOD;
- Colour choice of façade materials will be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development;
- Highly visible façades, located at sensitive edges and/or facing key spaces will be treated using high quality materials and detailing;
- Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades will provide variation and interest through use of setbacks, varied roofline and use of materials and planting;
- Treatment of façades will be sensitive in scale and the use of materials;
- Materials for less visible façades will be robust and designed to age well;
- Planting at the West Forum will reinforce the visual connection from the upper areas to the wider landscape and the Southern Ecological Corridor;
- Existing mature planting and hedgerows within the East Pond area and along the Southern edge will be maintained with the appropriate tree buffer zone. New tree planting will be accommodated within the East Pond space (to the north of the pond) to ensure that new development is set within landscape;
- Large feature tree planting will be provided at a minimum of 5 key locations within The Green public open space area, such as at the gateways to The Green or key nodes within the space – Where large trees are planted they will be given the appropriate environmental conditions and space to grow to maturity;
- Large feature tree planting will be provided at a minimum of 5 key locations along the Southern edge – Where these trees are planted they will be given the proper environmental conditions and space to grow to maturity and will be provided with a 15m buffer, in accordance with the Woodland Management Plan (Appendix 8.4, Volume 3);
- Supplemental new planting to the Southern edge will be provided to ensure a soft edge to the Site and a transition from the Site to open countryside;
- Large feature tree planting will be incorporated at key locations along High Cross, such as: the gateway to Madingley Road and the interface with The Green – Large tree species will be given the appropriate environmental conditions and space to grow to maturity;
- Large feature tree planting will be incorporated at key spaces along JJ Thompson Avenue such as the gateway to Madingley Road and the interface with The Green – Large tree species will be given the appropriate environmental conditions and space to grow to maturity;
- The buffer along the Madingley Road edge will serve as a screening element for the Proposed Development – The buffer will be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3);
- Any gaps or setbacks in development frontages along Madingley Road will contain landscape planting and greenery to soften the development edge;
- Any new landscaped gaps between buildings along the western edge will be a minimum of 20m from building face to building face;
- The impact of plant (and rooftop plant in particular) on building design and on open spaces will be carefully considered from the concept stage of design;
- Wherever possible, plant will be placed on roofs in locations where it will not be visible from the public realm;
- Any plant required to be provided as a separate structure will not be located next to or within the key open spaces;
- Screening or parapets around plant locations will be employed to reduce visibility of plant locations and reduce clutter;
- Long distance views will be considered in the location of plant;
- Plant will be considered as a way to add variation and interest in the roofscape;
- Medium and large plant will be considered as part of architectural concepts and building massing as an additional storey of the building. The roof plant will unavoidably be visible from public realm and so will be treated with appropriate materials;
- Visual impact of large plant areas will be reduced by breaking their volume and providing variation in rooflines;
- Any parts of building facade related to plant will not be inferior to the rest of the facade in materials and treatment;
- If larger flues are required, they will be treated as part of the architectural concept design and placed in locations that do not overwhelm key open spaces;
- Where service areas, multi storey car parks and development 'backs' are located along the edges, they will be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed;

- Rooftop plant will be set back from the Southern Building Zone edge and there will be effective screening of all rooftop plant, when viewed from the south;
- Any new artificial lighting to buildings or spaces will ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone;
- An artificial lighting scheme will be submitted with each reserved matters application:
- Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan;
- Rooftop plant shall not be located within the 32m AOD zone along Madingley Road;
- Any rooftop plant within the 37m or 41m AOD zone along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road;
- The three north-south running streets and the Central Green Link shall have building to building width with a minimum of 30m.

8.4 Summary

8.4.1 The operational phase will result in a densification of the Site with new contemporary institutional and commercial buildings which will be visible from long distances and result in an urbanising effect at the edge of the city. At the opening year, this will result in temporary significant adverse effects to the following landscape and visual receptors:

- Landscape character area C – West Cambridge Central Core;
- Landscape character area E – Madingley;
- Landscape character area F – Coton;
- Landscape character area G – Grantchester;
- Viewpoint 1 – Public viewpoint within the Coton Countryside Reserve;
- Viewpoint 3 – Harcamlow Way (39/31a);
- Viewpoint 4 – Wimpole Way (39/31a);
- Viewpoint 5 – Clerk Maxwell Road;
- Viewpoint 6 – Wilberforce Road;
- Viewpoint 7 – Dane Drive;
- Viewpoint 8 and 9 – Conduit Head Road and Madingley Road;
- Viewpoint 10 – Public Right of Way to the south of Harcamlow Way (55/9);
- Viewpoint 12 – Madingley Road (East)
- Viewpoint 14 – Public Right of Way to the west of Laundry Farm (55/6); and
- Viewpoint 16 – Barton Road.

8.4.2 Fifteen years after opening the screening vegetation and landscape planting will have matured which will soften the built form of the Proposed Development and maximise the screening effect of boundary planting. This will reduce the magnitude of the impact of the Proposed Development. At year fifteen after opening there will be significant effects to the following landscape and visual receptors:

- Landscape character area C – West Cambridge Central Core;
- Landscape character area E – Madingley;
- Landscape character area F – Coton;
- Landscape character area G – Grantchester;
- Viewpoint 1 – Public viewpoint within the Coton Countryside Reserve;
- Viewpoint 6 – Wilberforce Road;
- Viewpoint 7 – Dane Drive;
- Viewpoint 8 and 9 – Conduit Head Road and Madingley Road;
- Viewpoint 10 – Public Right of Way to the south of Harcamlow Way (55/9); and
- Viewpoint 12 – Madingley Road (East).

8.4.3 These significant effects on landscape and visual receptors should be considered in the context of the existing planning permission which allows for dense built development along the southern boundary of the Site. Many of the significant effects to visual receptors to the south of the Site from the Proposed Development would occur if the existing planning permission were to be fully built out.

ATKINS

10. Traffic and transport

10.1 Introduction

10.1.1 This chapter updates the traffic and transport assessment in the submitted ES to show the changes resulting from further detailed discussions with Highways England, Cambridge City Council and Cambridgeshire County Council in 2016 and 2017. This has resulted in further work being undertaken to the modelling that informed the Transport Assessment specifically relating to:

- The cumulative development quantum assumed across the region, to reflect the full Local Plan allocations;
- Updated person trip data for the land uses within West Cambridge;
- Updated local traffic count data following completion of local roadworks;
- Alternative trip length data sources to synthesise the origins of West Cambridge Development trips; and
- Locally, the assignment of West Cambridge trips to reflect amendments to the on-site car parking provision.

10.1.2 The following sections require updating to reflect the amended Proposed Development and are presented in this chapter:

- Scope of assessment;
- Relevant legislation and policy;
- Method of assessment;
- Baseline conditions;
- Impact assessment;
- Mitigation measures;
- Summary.

10.2 Scope of the assessment

10.2.1 The Transport chapter provides the details of development impacts on the existing transport network for walk, cycle and public transport usage, as well as from vehicular traffic.

10.2.2 Reflecting the subject matter and order of topics as stated in the Guidelines for the Environmental Assessment of Road Traffic, this Chapter considers significant effects deriving from any:

- Severance;
- Driver delay;
- Pedestrian delay (also considering cyclist delay);
- Pedestrian amenity (also considering cyclist amenity);
- Fear and intimidation;
- Road safety; and
- Hazardous loads.

10.2.3 No hazardous loads are associated with the construction, operation or decommissioning of the Proposed development and therefore have been scoped out of the assessment.

10.2.4 The potential effects of the Proposed Development have been considered for the following three scenarios:

- The effects of the Construction Phase of Development – this is assessed in the context of the 2016 Base flows;
- The operational effects of completion of the Initial Phase of Development in 2021 – cumulative impact assessment; and
- The operational effects of the Full Development in 2031 – cumulative impact assessment.

10.2.5 This assessment refers to the detailed Transport Assessment prepared in support of the Proposed Development. The Transport Assessment document is separate to the Environmental Statement.

10.2.6 A list of consultation responses received from statutory consultees during the EIA process relating to traffic and transport is presented in Table 10.1. All comments have been considered within this assessment.

Table 10.1 Traffic and transport scoping response

Issue raised	Respondent
The Guidance for Transport (2007) is now archived. Whilst still of value, and its use is welcomed in this process, this is not technically DfT guidance. The list of criteria should include the DfT Circular 02/2013 “The strategic road network and the delivery of sustainable development”, this being current DfT policy in terms of planning in regard to the SRN	David Abbott, Asset Manager - Area 8, Highways England
Natural England encourages any proposal to incorporate measures to help encourage people to access the countryside for quiet enjoyment. Measures such as reinstating existing footpaths together with the creation of new footpaths and bridleways are to be encouraged. The EIA should consider potential impacts on rights of way in the vicinity of the development. Appropriate mitigation should be incorporated for any adverse impacts. We also recommend reference to the relevant Right of Way Improvement Plans (ROWIP) to identify public rights of way within or adjacent to the proposed site that should be maintained or enhanced.	Janet Nuttall, Sustainable Land Use Advisor, Natural England
How has linking this development (and that proposed in NW Cambridge) to the city centre, railway station, Addenbrookes and other major sites within the Cambridge (sic) been included? This includes bus lanes, cycle routes, etc, as the A1303 has already become a challenge at peak times. Both Cambridgeshire County Council and the University should look at transport alternatives for all development. One alternative for consideration could be a new Guided Busway starting at St Neots through Cambourne and Bourne Airfield, Hardwick, Coton, then NW Cambridge, through West Cambridge and into the city along Barton Road.	Stacey Weiser, Head of Planning and Conservation, Cambridge Past, Present and Future

Issue raised	Respondent
Construction Environment Management Plan – Prior to the commencement of development or any reserved matters approval, a site-wide CEMP shall be submitted to and approved in writing by the local planning authority. The CEMP shall include the consideration of the following aspects of construction: (inter alia). b) Contractors' access arrangements for vehicles, plant and personnel including the location of construction traffic routes to, from and within the site, details of their signing, monitoring, and enforcement measures, along with location of parking for contractors and construction workers. Para 3.8.3 first sentence suggest amend to say 'The public transport provision will be developed to be complementary with the aspirations set out in the Transport Strategy for Cambridge and South Cambridgeshire, some of which will be delivered via the ongoing City Deal process'. Para 3.8.4: in Cambs cycle trips are made over longer distances than the typically assumed 5km national average. Para should be amended to reflect this. Para 3.8.7: last bullet 'smaller concentrations of cycle parking at a range of locations….' Para 9.3.9: At the end of para please add 'The study area for the Transport Assessment (TA) may well be more extensive as the use of a 30% threshold is not considered refined enough for the assessment of operational traffic and transport implications. Para 9.3.12: at the end of para please note 'there may be a need for immediate years to be considered in the TA so that the impacts of phasing understood'. Para 9.3.18: suggest adding the following to the end of this para 'It should be noted that these criteria relate to ES thresholds but it is recognised that in operational highway terms much lower thresholds can be important and will be considered via the TA process'. Para 9.3.20: are these thresholds relevant / applicable to local highways? Para 9.3.2: these thresholds sound too coarse for detailed assessment of pedestrian delays in a TA context.	Judith Carballo, Economy, Transport and Environment, Cambridgeshire County Council

10.3 Relevant legislation

National Planning Policy Framework (NPPF)[4]

10.3.1 A Transport Statement or Transport Assessment and Travel Plan should be provided for all developments that generate significant amounts of movement (Paragraphs 32 and 36 of the NPPF) and decisions should ensure that they "are located where the need to travel will be minimised and the use of sustainable transport modes can be maximised" (Paragraph 34), and take account of whether:

- The opportunities for sustainable transport modes have been taken up…;
- Safe and suitable access to the site can be achieved for all people; and
- Improvements can be undertaken within the transport network that cost effectively limits the significant impacts of the development.…

10.3.2 To facilitate the use of sustainable modes of transport, paragraph 35 states that, where feasible, developments should be located and designed to:

- Accommodate the efficient delivery of goods and supplies;
- Give priority to pedestrian and cycle movements, and have access to high quality public transport facilities;
- Create safe and secure layouts which minimise conflicts between traffic and cyclists or pedestrians…;
- Incorporate facilities for charging plug-in and other ultra-low emission vehicles; and
- Consider the needs of people with disabilities by all modes of transport.

Circular 02/2013 'Strategic Road Network and the Delivery of Sustainable Transport'[5]

10.3.3 Relevant policy is also set out in Circular 02/2013 'The Strategic Road Network and the Delivery of Sustainable Development' published by Highways England (then operating as the Highways Agency) in September 2013. This sets out the role of Highways England in engaging with communities and developers to deliver sustainable development and economic growth.

10.3.4 Paragraph 9 sets out the broad policy aims of the circular as it relates to development proposals, stating that:

"Development proposals are likely to be acceptable if they can be accommodated within the existing capacity of a section (link or junction) … or they do not increase demand for use of a section that is already operating at over-capacity levels, taking account of any travel plan, traffic management and/or capacity *enhancement measures that may be agreed….".*

10.3.5 With reference to decision making regarding developments, paragraph 9 continues:

*"However, development should only be prevented or refused on tran*sport grounds where the residual *cumulative impacts of development are severe".*

10.3.6 The emphasis of this document reflects national guidance, stressing the obligation placed on every developer to 'manage down' traffic generation from new development and to provide evidence that proposals for measures to reduce traffic generation from the site have been considered.

Cambridge Local Plan 2014[6]

10.3.7 15 strategic objectives are identified for the implementation of the Local Plan under the spatial vision for Cambridge, including:

- *"Promote and support economic growth in environmentally sustainable and accessible locations,* facilitating innovation... while maintaining the quality of life and place that contribute to economic success;
- Be located to help minimise the distance people need to travel, and be designed to make it easy for *everyone to move around the city and access jobs and services by sustainable modes of transport".*

4 Department for Communities and Local Government, March 2012, National Planning Policy Framework
5 Highways Agency (now Highways England) and the Department for Transport, September 2013, Strategic Road Network and the Delivery of Sustainable Development
6 Cambridge City Council, July 2013, Cambridge Local Plan 2014 Proposed Submission

10.3.8 Policy 5 of the spatial strategy regards strategic transport infrastructure, placing emphasis on modal shift and greater use of sustainable transport. In particular, the following points will be supported, with the ones relevant to West Cambridge identified:

- *"Promoting greater pedestrian and cycle priority through and to the city centre, district centres and* potentially incorporating public real and cycle parking improvements;
- Promoting sustainable transport and access for all to and from major employers, education and *research clusters…;*
- *Working with partners in supporting…city-wide cycle and pedestrian network by addressing 'pinch-points', barriers and missing links;*
- Linking growth to the proposed city-wide 20mph zone;
- Easing pressure on the air quality *management area in the city centre".*

10.3.9 Policy 18 identifies that densification of West Cambridge will be permitted, stating:

"Development of this area will be permitted in line with the existing planning permissions. The principal land uses will be:

- D1 educational uses, associated sui generis research establishments and academic research *institutes…*
- *A mix of commercial research uses within use class B1(b)…*

Small-scale community facilities, amenities, and A1 (local shop), A3 (café), A4 (public house), D1 (crèche) type uses and student accommodation will be acceptable, if they support existing occupants on the site and add to the social spaces and vibrancy of the area, essential to its continued success.

Any densification of development on the site that results in a significant increase in floorspace, over that already approved, will be supported providing that:

- A revised masterplan has been proposed that takes an integrated and comprehensive approach to the provision and distribution of the uses, and supporting facilities and amenities;
- Phasing of the development will be determined through the masterplan and as the need is proven;
- Development should not exceed four commercial storeys (16 metres in total) and given the sensitivity of the Green Belt to the south and west a lower overall height may be appropriate along these edges;
- Proposals respect the important adjacent Green Belt setting to the south and west, and other neighbouring residential uses and views of the city from the west;
- It includes a comprehensive transport strategy for the site, incorporating a sustainable transport plan to minimise reliance on private cars. This should include assessing the level, form and type of car parking on the site;
- That walking, cycling and public transport links (including access for all) to the city centre, railway station(s), other principal educational and employment sites, and other key locations within the city are enhanced to support sustainable development; and
- That proposals provide appropriate green infrastructure which is well integrated with the existing and new development and with the surrounding area.

Greater Cambridge City Deal[7]

10.3.10 The Greater Cambridge City Deal was agreed between the Government and the Greater Cambridge City Deal (comprising Cambridge City Council, Cambridgeshire County Council, South Cambridgeshire District Council, University of Cambridge, Greater Cambridge Greater Peterborough Local Enterprise Partnership) in June 2014, allowing Greater Cambridge to maintain and grow its status as a prosperous economic area, whilst maintaining ease of movement between economic hubs.

"Greater Cambridge needs to connect new developments to each other, and to existing research institutes, science and business parks; to Cambridge city centre and transport hubs...There will be new orbital bus routes around Cambridge and new high quality public transport links into Cambridge on key corridors *connecting with major employment centres."*

10.3.11 West Cambridge Development transport proposals align well with this aspect of the Greater Cambridge City Deal, making more efficient use of an existing hub, whilst maximising sustainable travel opportunities available from the 2014 City Deal.

Cambridgeshire Local Transport Plan 2011 – 2031[8]

10.3.12 The third Cambridgeshire Local Transport Plan (LTP3) sets out the transport objectives, policies and strategy for the county. The document was updated in 2014 "to reflect new data and changing context with regard to funding and development plans" and identifies large scale growth and the associated pressure on the transport network and the environment as a key issue affecting Cambridgeshire.

10.3.13 Having outlined the objectives of the LTP3, the document sets out 8 challenges for transport, along with strategies to address each challenge. The ones relevant to West Cambridge are discussed below.

- Challenge 2: Reducing the length of the commute and the need to travel by private car - "our transport strategy supports the development strategy for Cambridgeshire by aiming to reduce the need to travel and by providing sustainable travel options for new developments";
- Challenge 3: Making sustainable modes of transport a viable and attractive alternative to the private car - "by continuing to develop sustainable networks for walking and cycling, making it easier for people to change between modes of transport and working with bus operators to provide high quality bus services...We aim to improve the environment and safety for pedestrians, cyclists and public *transport users…Focus on raising awareness of transport choices available…this will include work with* local planning authorities to ensure provision for sustainable modes that form an integral part of new developments".

7 Deputy Prime Minister's office, June 2014, Greater Cambridge City Deal
8 Cambridgeshire County Council, July 2015, Cambridgeshire Local Transport Plan 2011-2031

Transport Strategy for Cambridge / South Cambridgeshire[9]

10.3.14 The Transport Strategy for Cambridge and South Cambridgeshire (TSCSC) ensures local councils plan together for sustainable growth and continued economic prosperity in the area. It was adopted by Cambridgeshire County Council in 2014 and is to be regularly reviewed given the extent of growth and development in the area. The strategy has two main roles for improving access across the area:

- To provide a detailed policy framework and programme of transport schemes for the area, addressing current problems, and being consistent with the Cambridgeshire LTP3;
- Supporting the Cambridge and South Cambridgeshire Local Plans, taking into account future levels of growth in the area and detailing the transport infrastructure and service necessary to deliver this growth.

10.3.15 The document sets out a number of transport policies and supporting strategies for the development of movement in the region:

- TSCSC 1 The strategy approach - "The transport network will support economic growth, mitigate the transport impacts of the growth and help protect the areas distinctive character and environment".
- TSCSC 2 Catering for travel demand in Cambridge - "More people will walk, cycle and use public transport services for journeys into, out of and within the city. More people will car share;"
- TSCSC 7 Supporting sustainable growth - "New development will be required to make provision for integrated and improvement transport infrastructure to ensure that most people have the ability to travel by foot, bicycle or by passenger transport and in line with specified modal split targets where relevant".
- TSCSC 9 Access to jobs and services – "Access to areas of employment and key services will be maximised, particularly by sustainable modes of travel, to:
  - *Provide a transport network that is efficient and effective;*
  - *Provide good accessibility to services and for businesses;*
  - *Provide a HQPT and cycle network to routes near major employment, education and service centres".*
- TSCSC 12 Encouraging Walking and Cycling" - "All new development must provide safe and convenient pedestrian and cycle environments including adequate and convenient cycle parking and ensure effective and direct integration with the wider network."

10.4 Method of assessment

Assessment approach

10.4.1 The method used to assess the effects of traffic associated with the Proposed Development is set out within the Transport Assessment. A transport model has been constructed of the local highway to evaluate the movement of trips generated by the Proposed Development on the external highway network in the area.

10.4.2 The assessment has been undertaken in accordance with the following guidelines:

- Guidelines for the Environmental Assessment of Road Traffic (IEMA) [10];
- Design Manual for Roads and Bridges (DMRB)[11];
- Local Cambridgeshire County Council guidance.

Scenarios

Year of assessment

10.4.3 It is anticipated that construction of the Proposed Development will commence in 2017 and will take around 14 years to build out, i.e. through to 2031. In order to examine this "worst case", the overall EIA has tested the operational phase in 2031 – this is coincidently, consistent with the Joint Authorities' latest available transport modelling assessment years for testing the emerging Local Plan.

10.4.4 Because of the timescales involved to 2031, this includes a substantial element of uncertainty in terms of

- Development delivery across the Cambridge Sub Region;
- The associated infrastructure provision necessary to accommodate this level, of growth particularly relating to:
  - The A14 Huntingdon – Cambridge Enhancement;
  - The Greater Cambridge City Deal transport proposals;
  - The A428 Black Cat to Caxton Gibbet Enhancement Scheme;
  - Highways England's currently unpublished proposals for the M11;
  - Other emerging transport proposals including - inter alia - the Oxford – Cambridge Expressway, and East-West Rail;
- The emerging development policy, including that enshrined within the Cambridge Local Plan.

10.4.5 As such, the transport modelling cannot robustly define a baseline scenario for 2031.

10.4.6 For the purposes of assessing the transport effects of the Proposed Development, the principles of the proposed strategy have been discussed and agreed with Joint Authorities. This "Adaptive Phased Approach" is summarised as incorporating both:

- A graduated approach – the assessment process reflecting current transport planning policy where travel demand management measures are introduced first, followed by any necessary highway infrastructure measures to mitigate the residual traffic impact; as well as
- An adaptive approach – where, to maintain future flexibility, the proposed mitigation for later phases responds to the quanta of development within the individual phase proposals, the timescales for the delivery, changes in future travel behaviour patterns, emerging transport policy, and the current uncertainty relating to the development and transport infrastructure enhancement proposals.

10.4.7 The effect of the Proposed Development has been assessed with reference to the:

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9 Cambridgeshire County Council, April 2014, Transport Strategy for Cambridge and South Cambridgeshire
10 Institute of Environmental Assessment, 1993, Guidelines for the environmental assessment of road traffic
11 Highways Agency, 1993, Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 8 Pedestrians, Cyclists, Equestrians and Community Effects

- Do Minimum (i.e., with the Constructed West Cambridge Development, and all other committed and consented highway enhancements and developments than the Proposed Development); and
- Do Something scenarios (i.e., with the committed and consented highway enhancements and developments as well as the relevant phase of the Proposed Development).

10.4.8 The following scenarios have therefore been considered:

- Baseline
  - 2016 Baseline;
  - 2021 Do Minimum;
  - 2031 Do Minimum;
- Future
  - 2016 With Construction (assumed to have the greatest traffic impact);
  - 2021 Do Something - (reflecting committed and proposed developments including the Initial Phase of the Proposed Development as per Table 6.2); and
  - 2031 Do Something - (reflecting committed and proposed developments including the Proposed Development in its completed form).

Development quanta

10.4.9 The development quanta assumed for West Cambridge in the 2021 and 2031 Do Minimum assessments reflects the existing development in the study area.

10.4.10 For the 2021 Do Something scenario, it has been agreed that an indicative Initial Phase of Development be assumed and assessed, the composition of this Initial Phase of West Cambridge Development is shown in Table 10.2, with the assumed completion in 2021.

Table 10.2 Proposed Initial Phase of West Cambridge Development – Land Use Mix

Lane Use (GFA)	Area (m^2)
Academic Research (m^2)	168,259
Commercial Research and Research Institute (m^2)	92,386
Nursery (m^2)	1,900
Shop, Café Restaurant, Pub - A1-A5 (m^2)	350
Assembly and Leisure	6,060
Residential (m^2)	10,680
Ancillary Infrastructure (data centre, energy centre)	7,675
Total (m^2)	287,310

10.4.11 The Full Development quanta assumed for 2031 reflects the composition as stated in Chapter 3.

Access Strategy

10.4.12 Measures envisaged to mitigate the likely significant effects of this indicative Initial Phase are included later in this chapter.

10.4.13 Acknowledging that there is uncertainty regarding future development and transport infrastructure proposals, and that these would have a significant and substantial impact upon future traffic flows in the local area, as discussed with the Joint Authorities it is not appropriate to define further mitigation measures at this stage beyond an indicative Initial Phase of development (assumed to be 2021).

10.4.14 The supporting development access strategy is considered by mode within the respective Sections of the Transport Assessment as summarised below:

- Pedestrian and Cycle strategy - Section 6
- Public Transport Strategy – Section 7
- Travel Demand Management Strategy – Section 9
- Site Layout, Vehicular Access and Parking - Section 8.

10.4.15 As defined in the latter, the Vehicle access will be provided to the Development by a series of existing, enhanced and new vehicular access points off Madingley Road. These will be delivered through the duration of the Development, to a programme to be determined. These access points assumed for the 2021 assessment for the Initial Phase of Development are:

- The existing traffic signal controlled High Cross junction;
- The existing JJ Thomson Avenue priority junction; and
- The existing Clerk Maxwell Road priority junction providing access to a single Proposed Development car parking facility only.

10.4.16 In addition, a further priority junction formerly serving the Veterinary School (currently closed), between JJ Thomson Avenue and High Cross would be opened and enhanced to provide limited service access only to the occupiers immediately adjacent Madingley Road.

10.4.17 For the 2031 assessment, the above three accesses are assumed, along with a new traffic signal controlled, restricted movement (right in / left out), access junction onto Madingley Road at the western end of the site, which would connect to the Western Access Road.

Establishing the baseline

Survey data

10.4.18 For the purposes of the traffic assessment, traffic count survey data has been collated from both existing sources as well as the commissioning new traffic count surveys in order to set out baseline traffic flows.

10.4.19 Traffic Turning Count Surveys were commissioned by the University of Cambridge at the flowing junctions and were undertaken on 25th November 2014 by Advanced Transport Research (ATR):

- Madingley Road / JJ Thomson Avenue;
- Adams Road / Wilberforce Road;
- Grange Road / Adams Road / Burrell's Walk;

- Madingley Road / Clerk Maxwell Road; and
- Madingley Road / Madingley Rise.

10.4.20 Additional traffic turning count surveys were undertaken by Sky High Technology on Tuesday 30th June 2015 at the following junctions:

- A1303 / A428 / St Neots Road roundabout;
- M11 Junction 13 Off-Slip / Madingley Road West junction;
- M11 Junction 13 On-Slip / Madingley Road East junction;
- Madingley / Grange Road priority junction;
- Huntingdon Road / Girton Road priority junction;
- Huntingdon Road / Storey's Way priority junction;
- Barton Road / Grange Road priority junction;
- Madingley Road / Cambridge Road crossroad priority junction;
- Madingley Road / Lady Margaret Road priority junction; and
- Madingley Rd / Northampton St / Queen’s Road mini roundabout junction.

10.4.21 Further manual classified turning counts were commissioned by the University in October 2016 at the following junctions:

- A428 / A1303 Madingley Mulch Roundabout;
- Madingley Road / Cambridge Road crossroad priority junction;
- M11 Junction 13 East traffic signal controlled junction;
- M11 Junction 13 West priority junction;
- Madingley Road / Park and Ride traffic signal controlled junction;
- Madingley Road / High Cross / Eddington Avenue traffic signal controlled junction;
- Madingley Road / Madingley Rise / JJ Thomson Avenue Crossroads; and
- Madingley Road / Clerk Maxwell Road priority junction.

10.4.22 Automatic Traffic Counts (ATC) were commissioned by the University of Cambridge to undertake a two week-long ATC at the following location sites from 17th June to 30th June 2015 by Sky High Technology:

- Barton Road – east of Grantchester Road;
- JJ Thomson Avenue;
- Grange Road – north of Clarkson Road; and
- Madingley Road – west of M11 Junction 13.

10.4.23 These ATC surveys were primarily commissioned to inform the daily composition of the vehicle movements, especially to inform the noise and air quality assessments of the Proposed Development.

10.4.24 The Highways England Traffic Information Database (WebTRIS) website has been referred to, to provide volumetric and classified traffic flow information for the strategic highway for 2016 at:

- M11 Junction 13; and
- A14 – Junction 32

10.4.25 The Highways England Traffic Information Database (TRADS) website was referred to earlier, to provide volumetric and classified traffic flow information for the strategic highway for 2014 at:

- A14 – Junction 30 and section near to Girton.

Growth factors

10.4.26 Highways England Trip End Model Presentation Program (TEMPRO) database was used to provide the local growth factors for the Cambridge area as required, these are summarised in Table 10.3, the details shown in Appendix 10.4.

Table 10.3 TEMPRO growth factors

TEMPRO V.7.0.0 Growth Factors										
Road Classification	**2015-2016 Cambridge 005 (E02003723)**		**2015-2016 Cambridge 007 (E02003725)**		**2015-2016 Cambridge 009 (E02003727)**		**2014-2016 Cambridge 009 (E02003727)**		**2013-2016 Cambridge 007 (E02003725)**	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Urban Trunk	1.0129	1.015	1.0151	1.0176			1.0425	1.0436		
Urban Principal Road	1.0118	1.014	1.014	1.0166					1.041	1.0487
Urban Minor Road	1.012	1.0141	1.0141	1.0167						
Rural Motorway	1.0142	1.0164	1.0164	1.019			1.0454	1.0464		
Rural Trunk	1.0151	1.0173	1.0173	1.0199	1.0239	1.0244	1.0465	1.0475		
Rural Principal	1.0126	1.0147	1.0148	1.0173						

Highway flow data

10.4.27 The trip generation from West Cambridge has been assessed for all scenarios; (Current – 2016), Do Minimum (Constructed) and Do Something for the two 2021 Initial Phase and 2031 Full Development tests, using:

- Peter Brett Associates' Transport Model; in combination with
- Observations – including person trip surveys, and site access vehicle trip movement counts.

10.4.28 Peter Brett Associates developed a first-principles Transport Model independently to assess development trip generation, distribution and mode share in this area. The West Cambridge Person Trip Model element was based on the previously-approved north west Cambridge Model - albeit expanded considerably to incorporate:

- The West Cambridge Development;
- Demographic information contained within the updated 2011 Census data and the National Travel Survey;
- The trip generation from the allocated strategic developments included within the Cambridge Local Plan; and
- The results of the 2016 University staff data postcode data analysis.

10.4.29 Further details are provided below.

Base year traffic flows (2016)

10.4.30 The 2016 vehicle flows will be derived across the network from the most appropriate source, including inter alia:

- The traffic count survey - including automatic traffic counts and manual part-classified junction turning counts - undertaken across a wider area in June 2015 as part of this West Cambridge Development (commissioned by the University following the initial Transport Assessment Scoping in May 2015);
- Further traffic count surveys undertaken along Madingley Road in October 2016 as part of the West Cambridge Development Annual Monitoring (commissioned by the University in September 2016);
- Traffic count survey data provided by Cambridgeshire County Council;
- Traffic count survey data from Highways England's TRADS and Web TRIS databases; and
- Growth factors from the Department for Transport's TEMPRO model will be used to convert all the survey results to the common year of 2016.

Calculation of 2021 traffic

10.4.31 The 2016 network traffic flows will be increased by the vehicle trips identified by Peter Brett Associates' Transport Model arising from the consented strategic development delivered by 2021 assigning along each link.

10.4.32 These 2021 flows, being based in part on observation from the surveys in 2016, would already include movements associated with West Cambridge. For the purposes of assessing the 2021 Do Something scenario for the Transport Assessment, to avoid double counting the existing West Cambridge development-generated vehicle trips:

- The Modelled 2016 West Cambridge vehicle movements would be deducted by link;
- These Modelled 2016 West Cambridge vehicle movements would be replaced with the predicted Proposed Development (Initial Phase of the Do Something scenario) also identified by the Transport Model.

10.4.33 To provide reassurance to the accuracy of these flow increases, the resulting increases in link flow will be considered with reference to the appropriate growth factor obtained from the Department for Transport's TEMPRO model. The flows are summarised in Appendix 10.3.

Calculation of 2031 traffic

10.4.34 The 2016 network traffic flows will be increased by the vehicle trips identified by Peter Brett Associates' Transport Model arising from the consented strategic development delivered by 2031 assigning along each link.

10.4.35 These 2031 flows, being based in part on observation from the surveys in 2016, would already include movements associated with West Cambridge. For the purposes of assessing the 2031 Do Something scenario for the Transport Assessment, to avoid double counting the existing West Cambridge development-generated vehicle trips:

- The Modelled 2016 West Cambridge vehicle movements would be deducted by link;
- These Modelled 2016 West Cambridge vehicle movements would be replaced with the predicted Proposed Development (Full Do Something scenario) identified by the Transport Model.

Calculation of construction traffic generation

10.4.36 For the Proposed Development, a first-principles approach has been undertaken to derive the peak construction trip generation assumptions used in this assessment. These flows are summarised in Table Appendix 10.1.

10.4.37 Reference has been made to the Construction Environmental Management Plan (CEMP) prepared by Peter Brett Associates in 2016 for West Cambridge to ascertain these movements.

Study area

10.4.38 The initial area of study agreed with the Joint Highway Authorities during the Transport Scoping exercise is shown on Figure 10.1.

10.4.39 The Institute of Environmental Assessment (now Institute of Environmental Management and Assessment (IEMA)) guidelines[12] suggest that for environmental impact, traffic flow increases (or HGV increases) of 30% represent a reasonable threshold for inclusion of highway links within the assessment process, although a lower threshold may be appropriate, for example, where there are higher HGV flows. It also suggests that links with traffic flow increases of 10% or more should be assessed in other sensitive areas. This has been used to inform the links assessed.

10.4.40 The transport modelling has calculated that the below listed links will experience a 30% or greater change in traffic flows in 2031 as a result of natural growth, plus growth from the specific cumulative developments and the Proposed Development.

- Link 1.3 – M11 J13 off-slip and on-slip;
- Link 3.2 – Madingley Road on Over Bridge M11;
- Link 3.3 – Madingley Road - Between M11 south bound on-slip to proposed Madingley Rd West Access;
- Link 3.6 – Madingley Road – East of Proposed High Cross Access;
- Link 3.7 – Madingley Road – East of JJ Thomson Avenue;
- Link 3.8 – Madingley Road – East of Clerk Maxwell Road;
- Link 3.9 – Madingley Road – East of Storey's Way;
- Link 3.10 – Madingley Road – East of Grange Road;
- Link 3.11 – Madingley Road – West of Queen's Road / Northampton Street roundabout;
- Link 3.12 – Northampton Street – West of Pound Hill;
- Link 4.0 – Huntingdon Road – West of Proposed NWC HRW Access;
- Link 4.2 – Huntingdon Road – East of NWC HRW Access;
- Link 4.3 – Huntingdon Road – East of NIAB Access;
- Link 4.4 – Huntingdon Road – East of Storey's Way
- Link 12.1 – High Cross Access to Madingley Road;
- Link 12.2 – JJ Thomson Ave Access to Madingley Road;
- Link 12.3 – Clerk Maxwell Road – South of Car Park Access; and
- Link 12.4 – Clerk Maxwell Road – North of Car Park Access.

10.4.41 Similarly, the transport modelling has calculated that the below listed links will experience a 10% or greater change in traffic flows in 2031 as a result of natural growth, plus growth from cumulative developments and the Proposed Development.

- Link 4.1 – Huntingdon Road – South East of Grange Drive;
- Link 6.0 – Queen's Road – North of West Road;
- Link 9.0 – Storey's Way – between Madingley Road and Huntingdon Road; and
- Link 10.0 – Girton Road – North of Huntingdon Road.

[12] Institute of Environmental Assessment, 1993, Guidelines for the Environmental Assessment of Road Traffic

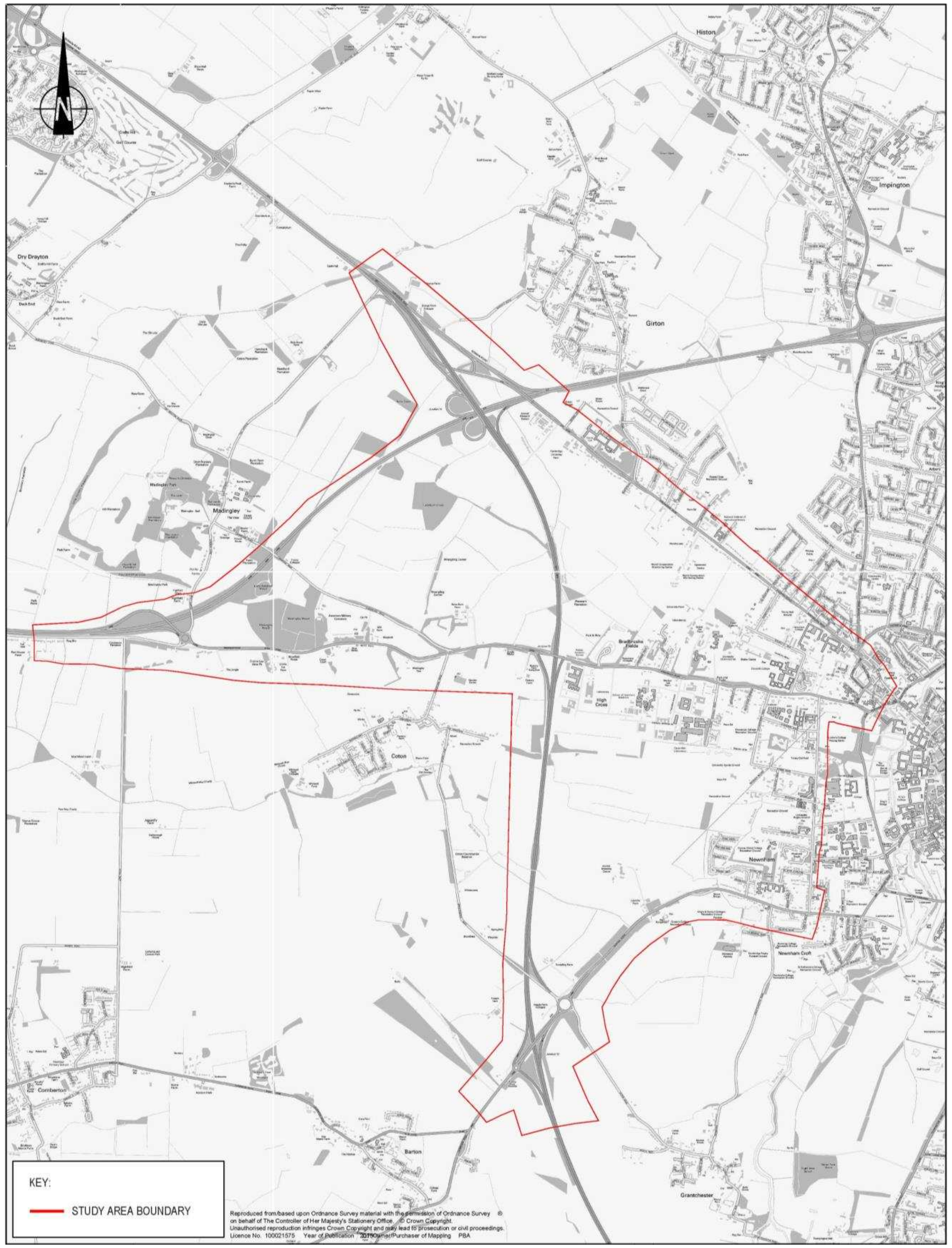

Figure 10.1 Study Area

Impact assessment

10.4.42 The method and significance criteria used in this assessment reflect that within the guidance documents referenced earlier within this Chapter, together with professional judgement.

10.4.43 The significance of effect is derived from a combination of the Sensitivity (or importance) of the receptors affected, and the magnitude (or scale) of impact from the change on the receptors. These three factors are considered individually.

Sensitivity

10.4.44 For the transport-related effects considered in this chapter, categories of receptor sensitivity have been defined from the principles set out in the IEMA Guidelines as set out in Table 10.4

Table 10.4 Sensitivity of receptors

Sensitivity	Receptor
High	• Schools, colleges and other educational institutions; • Retirement / care homes for the elderly or infirm; • Roads used by pedestrians with no footways; and • Road safety black spots.
Medium	• Hospitals, surgeries and clinics; • Parks and recreation areas; • Shopping areas; and • Roads used by pedestrians with narrow footways.
Low	• Open space; • Tourist / visitor attractions; • Historical buildings; and • Churches.

10.4.45 In addition, although not specifically identified within the IEMA Guidelines as being sensitive, it has been assumed that residential areas and employment areas have low sensitivity to these effects, as they typically experience regular traffic movements on a day-to-day basis.

Magnitude of impact

10.4.46 The magnitude of impact depends upon the category of traffic effects being assessed, and this has been based on the guidance relating to Severance (as set out below) which suggests that 0%, 30%, 60% and 90% changes in traffic levels should be considered as "negligible", "minor", "moderate" and "major" impacts respectively.

10.4.47 IEMA's guidelines set out the broad principles of how to assess the magnitude of effect for each category of potential environmental impact. This is summarised below by category.

Magnitude of impact – Severance

10.4.48 The IEMA guidance states that "severance is the perceived division that can occur within a community when it becomes separated by a major traffic artery." Further, "Changes in traffic flow of 30%, 60% and 90% are regarded as producing 'slight', 'moderate' and 'substantial' changes in severance respectively". However, the guidance acknowledges that the measurement and prediction of Severance is extremely difficult. The assessment of Severance pays full regard to specific local conditions, in particular the location of pedestrian routes to key local facilities and whether or not crossing facilities are provided. For the purposes of this assessment, motorway and dual carriageway links where walking and cycling are excluded or the numbers extremely limited have not been included in the assessment tables.

10.4.49 Volume 11, Section 3, Part 8, Chapter 6 of the Design Manual for Roads and Bridges dated 2006 (the "DMRB") provides further guidance on this aspect of Severance in terms of the 2-way Annual Average Daily Traffic Flow (AADT) on a link. It states that new Severance should be described in terms of "Slight", Moderate" or Severe" and that these categories " … should be coupled with an estimate of the numbers of people affected, their location and the community facilities from which they are severed".

10.4.50 These descriptions of Severance have been adapted to maintain consistency with this assessment - these are now referred to as "Low", "Medium" and "High". For anything less than low significance, no such estimate of the numbers of people affected need be made. A further severance level of negligible has been incorporated for this reason. Table 10.5 summarises these thresholds.

Table 10.5 Pedestrian Severance threshold (DMRB)

Magnitude	AADT
High	> 16,000
Medium	8,000 - 16,000
Low	4,000 - 8,000
Negligible	< 4,000

10.4.51 In addition, (with specific reference to relief from existing Severance), the DMRB Guidelines acknowledge that there is a traffic flow threshold below which Severance is not considered significant where the AADT (daily) flow is below 8,000 vehicles.

Magnitude of impact – Driver Delay

10.4.52 Driver delays "… are only likely to be significant when the traffic on the network surrounding the development is already at, or close to, the capacity of the system."[10]

Magnitude of impact – Pedestrian Delay

10.4.53 "Changes in the volume, composition or speed of traffic may affect the ability of people to cross roads." The guidance suggests that assessors "… use their judgement to determine whether pedestrian delay is a significant effect." [10]

10.4.54 For the purposes of this assessment, the pedestrian Severance threshold levels identified in Table 6.5 above have been applied to pedestrian delay.

10.4.55 Although the IEMA's Guidelines for the Environmental Assessment of Road Traffic only considers pedestrian delay consideration is also given to cyclist delay.

Magnitude of impact – Pedestrian Amenity

10.4.56 This is broadly defined as the relative pleasantness of a journey; it is affected by traffic flow, traffic composition and pavement width / separation from traffic. The guidance suggests a tentative threshold for judging the significance of changes in pedestrian amenity of where traffic flow (or its heavy vehicle component) is halved or doubled.

10.4.57 Although IEMA's Guidelines for the Environmental Assessment of Road Traffic only considers Pedestrian Amenity, within the assessment of the West Cambridge Development consideration is also given to Cyclist Amenity.

Magnitude of impact – Fear and Intimidation

10.4.58 The effect of this is dependent upon the volume of traffic, its heavy vehicle composition, its proximity to people or the lack of protection caused by such factors as narrow pavement widths.

10.4.59 Receptors are assessed as being pedestrians and cyclists. For the purposes of this assessment, the highest road category links (such as the M11 motorway and the A14 / A428 dual carriageways) do not have pedestrian / cyclist facilities, the use by these users of these links is minimal, if any. As no receptors would be present on these links, these links have not been included within the assessment tables below.

10.4.60 The IEMA guidelines state that there are no commonly agreed thresholds for estimating "fear and intimidation" from known traffic and physical conditions, but it does nevertheless suggest some thresholds which could be used, based on previous research, and these are shown in Table 10.6.

Table 10.6 Fear and Intimidation thresholds

Degree of hazard	Average traffic flow over 18 hr day – vehicles / hour 2-way	Total 18 hour heavy vehicle flow	Average vehicle speed over 18 hour day - mph
High	+1,800	+ 3,000	+20
Medium	1,200 – 1,800	2,000 – 3,000	15 – 20
Low	600 - 1,200	1,000 – 2,000	10-15
Negligible	<600	<1,000	<10

Note 1: Although no category is given in the guidance for flows less than the "Low" (was Moderate") threshold, this has been added to the table.

Note 2: These categories of degree / magnitude of hazard have also been expressed consistently with the terms used in this assessment as High, Medium, Low, and Negligible.

Magnitude of impact – Accidents and safety

10.4.61 The guidance[10] suggests that "Professional judgement will be needed to assess the implications of local circumstances, or factors, which may elevate of lessen risks of accidents, e.g. junction conflicts".

Significance of effect

10.4.62 The sensitivity of the receptor and the magnitude of impact are combined to give the overall significance of effect for both beneficial and adverse conditions as shown in Table 10.7 Definitions for the effect significance are given in Table 10.8

Table 10.7 Significance of Effect Categories

		Sensitivity		
		High	**Medium**	**Low**
Magnitude of impact)	**High**	Major	Major	Moderate
	Medium	Major	Moderate	Minor to Moderate
	Low	Moderate	Minor to Moderate	Minor
	Negligible	Negligible	Negligible	Negligible

Table 10.8 Generic Significance Criteria

Significance Level	Criteria
Major	These effects are likely to be important considerations at a local or district scale
Moderate	These effects are likely to be important considerations at a local scale
Minor	These effects may be raised as local issues but are unlikely to be of importance.
Negligible	No effect or effect which is beneath the level of perception, within normal bounds of variation or within the margin of forecasting error.

10.4.63 In addition to the above, as the percentage of increased traffic is a function of the level of baseline traffic flows. Trigger levels in terms of absolute levels of increase have been introduced to prevent very minor changes on links with low baseline flows from being considered as more significant.

10.4.64 For example, a change in traffic flow of greater than 90% on a road with a high sensitive receptor would result in a ‘major significant effect’. However, the existing baseline traffic flows could be very minor and an increase of only a few vehicles would produce a large change in magnitude whereas in real terms the increase in traffic is still considered to be insignificant. Therefore, reference has been made to the Fear and Intimidation threshold trigger levels in Table 6.6 where a significant effect is only considered to occur if the baseline traffic flow is increased to any of the trigger levels identified.

Assumptions and limitations

10.4.65 As agreed with CCC and Highways England, the transport-related technical assessment work used to support the development is based on Peter Brett Associates’ Transport Model.

10.4.66 To create the Baseline, this Transport Model includes the Constructed West Cambridge Development, and all other committed and consented highway enhancements and developments than the Proposed Development. The assumptions included within the model for these developments were agreed with the Joint Authorities and represent the best available information at the present time.

10.4.67 Whilst this Transport Model is a suitable tool for assessing the strategic impact of West Cambridge and steps have been undertaken to ensure the assignment of the model trips on local routes around the development reflects the current reality, minor limitations inherent in all such transport models may remain. As this concern relates to the assignment choice of trips from the south and east of the City using the local roads to assign to the Proposed Development rather than the strategic network, this will not have a significant adverse impact on the conclusions of this EIA process.

10.4.68 Typical construction traffic movements have been based on experience of other similar projects.

10.4.69 This assessment of the indicative peak daily construction two-way flows arising from the Proposed Development has been completed in advance of appointing a contractor, or defining the development programme completion targets. As a result of the range of construction projects and processes occurring on any one day, there is wide variation in the flows accruing to the construction of a multi-occupancy development such as the Proposed Development. Typically, the final rate of project completion reflects many competing factors – such as construction access to the Development, agreeing the final occupiers of the buildings, availability of labour or materials (such as concrete or bituminous material) as well as maintaining a quality environment during the early phases of a project during these construction phases. Nevertheless, a reasonable worst case assessment of the likely extent of construction-related activities occurring at any one time has been made for the purposes of assessing environmental effects. This has been forecast to occur during the construction of the infrastructure enabling works.

10.5 Baseline conditions

10.5.1 The following existing conditions are contained within the respective Sections of the Transport Assessment as summarised below:

- Existing Pedestrian and Cycle Facilities - Section 3.3
- Existing Bus Services – Section 3.4
- Existing Rail Services – Section 3.5
- Existing Vehicular Access - Section 2.7
- Existing Road Network – Section 3.6
- Public Rights of Way – Section 3.3
- Road Safety Assessment – Section 3.9

Receptors

10.5.2 A review of the Study Area has been undertaken to understand the receptors potentially affected by the traffic generated by the Proposed Development in the general area of the Development. These Sensitive Receptors are shown in Table 10.9 and Figure 10.3. In addition, the receptors on the links identified in Section 10.3 as experiencing increases in flow of greater than 30% / 10% are listed in Table 10.9.

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Table 10.9 Sensitive receptors

Reference on Figure 10.3	Receptor	Sensitivity
Barton Road		
1	Wolfson College	High
Grange Road		
2	Robinson College	High
3	Margaret Beaufort Institute	High
4	Selwyn College	High
Huntingdon Road		
5	Murray Edwards (ex-New Hall) College and Art Collection	High
6	Westfield House (tertiary education)	High
7	Girton College	High
8	Church	Low
9	Blackfriars Priory	Low
JJ Thomson Avenue		
10 & 11	University of Cambridge Dept of Veterinary Medicine	High
12	University of Cambridge Cavendish Laboratory	High
Madingley Road		
13	Madingley Windmill	Low
14	American Cemetery	Low
Storey's Way		
15	Churchill College	High
16	Fitzwilliam College / Murray Edwards College	High
Road link	**Receptor**	**Sensitivity**
Link 1.3 – M11 J13 off-slip and on-slip;	Drivers on the slip roads	Low
Link 3.2 – Madingley Road on Over Bridge M11;	Drivers along Madingley Road	Low
	Pedestrians and cyclists travelling along Madingley Road	Low
Link 3.3 – Madingley Road between M11 On Slip – Proposed Madingley Road West Access	Drivers along Madingley Road	Low
	Pedestrians and cyclists travelling along Madingley Road	Low
Link 3.6 – Madingley Road – East of Proposed High Cross Access	Drivers along Madingley Road	Low
	Pedestrians and cyclists travelling along Madingley Road	Low
	Residents living along Madingley Road	Low
Link 3.7 – Madingley Road – East of JJ Thomson Avenue	Drivers along Madingley Road	Low
	Pedestrians and cyclists travelling along Madingley Road	Low
	Residents living along Madingley Road	Low
Link 3.8 – Madingley Road – East of Clerk Maxwell Road	Drivers along Madingley Road	Low
	Pedestrians and cyclists travelling along Madingley Road	Low
	Residents living along Madingley Road	Low

Reference on Figure 10.3	Receptor	Sensitivity
Link 3.9 – Madingley Road – East of Storey's Way	Drivers along Madingley Road	Low
	Pedestrians and cyclists travelling along Madingley Road	Low
	Residents living along Madingley Road	Low
Link 3.10 - Madingley Road – East of Grange Road	Drivers along Madingley Road	Low
	Pedestrians and cyclists travelling along Madingley Road	Low
	Residents living along Madingley Road	Low
Link 3.11 – Madingley Road – West of Queen's Road / Northampton Street	Drivers along Madingley Road	Low
	Pedestrians and cyclists travelling along Madingley Road	Low
Link 3.12 – Northampton Street – West of Pound Hill	Drivers along Northampton Street	Low
	Pedestrians and cyclists travelling along Northampton Street	Low
	Residents living at Northampton Street	Low
Link 4.0 – Huntingdon Road – West of Proposed NWC HRW Access	Drivers along Huntingdon Road	Low
Link 4.1 – Huntingdon Road – South East of Grange Drive	Drivers along Huntingdon Road	Low
	Pedestrians and cyclists travelling along Huntingdon Road	Low
	Residents living along Huntingdon Road	Low
	Girton College	High
	Westfield House	High
Link 4.2 – Huntingdon Road – East of NWC HRW Access	Drivers along Huntingdon Road	Low
	Pedestrians and cyclists travelling along Huntingdon Road	Low
	Residents living along Huntingdon Road	Low
Link 4.3 – Huntingdon Road – East of NIAB Access	Drivers along Huntingdon Road	Low
	Pedestrians and cyclists travelling along Huntingdon Road	Low
	Residents living along Huntingdon Road	Low
Link 4.4 – Huntingdon Road – East of Storey's Way	Westfield House	High
	Pedestrians and cyclists travelling along Huntingdon Road	Low
	Drivers along Huntingdon Road	Low
	Church	Low
Link 6.0 – Queen's Road – North of West Road	Drivers along Queen's Road	Low
	Pedestrians and cyclists travelling along Queen's Road	Low
Link 9.0 – Storey's Way – between Madingley Road and Huntingdon Road	Churchill / Fitzwilliam College / Murray Edwards Colleges	High
	Drivers along Storey's Way	Low
	Pedestrians and cyclists travelling along Storey's Way	Low

Reference on Figure 10.3	Receptor	Sensitivity
	Residents living on Storey's Way	Low
Link 10.0 – Girton Road – North of Huntingdon Road	Drivers along Girton Road	Low
	Pedestrians and cyclists travelling along Girton Road	Low
	Residents living on Girton Road	Low
Link 12.1 – High Cross Access to Madingley Road	Drivers along High Cross Road	Low
	Pedestrians and cyclists travelling along High Cross Road	Low
	Employees working at West Cambridge	Low
Link 12.2 – JJ Thomson Ave Access to Madingley Road	Drivers along JJ Thomson Avenue	Low
	Pedestrians and cyclists travelling along JJ Thomson Avenue	Low
	Employees working at West Cambridge	Low
Link 12.3 – Clerk Maxwell Road – South of Car Park Access	Drivers along Clerk Maxwell Road	Low
	Pedestrians and cyclists travelling along Clerk Maxwell Road	Low
	Residents living at The Lawns and Perry Close	Low
Link 12.4 – Clerk Maxwell Road – North of Car Park Access	Drivers along Clerk Maxwell Road	Low
	Pedestrians and cyclists travelling along Clerk Maxwell Road	Low

Baseline traffic flow information

10.5.3 Table 10.10 shows the predicted baseline traffic flows for the three assessment scenarios; 2016, 2021, and 2031. Increases in traffic flows between the three scenarios are attributed to natural growth, plus growth from the specific cumulative developments as referred to in paragraph 6.3.7.

Table 10.10 Baseline traffic flows for assessment years 2016, 2021, and 2031

Link	Estimated 24hr base 7-day flows all vehicles		
	2016	2021	2031
Link 1.3 – M11 J13 off-slip and on-slip;	17,265	20,208	21,742
Link 3.2 – Madingley Road on Over Bridge M11;	17,000	17,976	19,724
Link 3.3 – Madingley Road between M11 On Slip – Proposed Madingley Road West Access	19,311	21,109	22,859
Link 3.6 – Madingley Road – East of Proposed High Cross Access	15,573	17,207	18,634
Link 3.7 – Madingley Road – East of JJ Thomson Avenue	17,085	18,642	19,886
Link 3.8 – Madingley Road – East of Clerk Maxwell Road	16,805	18,416	19,660
Link 3.9 – Madingley Road – East of Storey's Way	15,112	17,000	18,213
Link 3.10 - Madingley Road – East of Grange Road	15,112	16,928	18,123
Link 3.11 – Madingley Road – West of Queen's Road / Northampton Street	16,317	18,806	19,660
Link 3.12 – Northampton Street – West of Pound Hill	13,706	15,725	16,664
Link 4.0 – Huntingdon Road – West of Proposed NWC HRW Access	10,644	13,874	15,410
Link 4.1 – Huntingdon Road – South East of Grange Drive	10,644	11,746	13,057
Link 4.2 – Huntingdon Road – East of NWC HRW Access	14,955	20,294	22,367
Link 4.3 – Huntingdon Road – East of NIAB Access	17,671	23,062	25,215
Link 4.4 – Huntingdon Road – East of Storey's Way	16,411	21,790	23,882
Link 6.0 – Queen's Road – North of West Road	14,928	15,788	16,508
Link 9.0 – Storey's Way – between Madingley Road and Huntingdon Road	3,215	2,800	2,825
Link 10.0 – Girton Road – North of Huntingdon Road	5,019	5,446	5,535
Link 12.1 – High Cross Access to Madingley Road	2,223	1,750	1,750
Link 12.2 – JJ Thomson Avenue Access to Madingley Road	2,289	2,365	2,365
Link 12.3 – Clerk Maxwell Road – South of Car Park Access	322	312	312
Link 12.4 – Clerk Maxwell Road – North of Car Park Access	851	802	802

Baseline severance

10.5.4 The existing levels of severance on the road network surrounding the Site are detailed in Appendix 10.2. All the link flows considered are as two-way flows on a particular link.

10.5.5 It is noted that although identified as experiencing high levels of Severance, no pedestrian and cyclists may use the M11, and would be discouraged from using the A14 or A428. As such, link 1.3 is not considered further in this assessment.

10.5.6 The existing and future level of Severance experienced within the vicinity of the Development on the local roads within the City area (i.e., excluding the M11, A14, A428 and rural lengths of the A1303) with sensitive receptors is shown in Table 10.11.

Table 10.11 Baseline Severance (24 hour all vehicle two way traffic flows)

Receptor	2016		2021		2031	
	Base traffic flow	Severance	Base traffic flow	Severance	Base traffic flow	Severance
Link 3.2 – Madingley Road on Over Bridge M11	17,000	High	17,976	High	19,724	High
Link 3.3 – Madingley Road between M11 On Slip – Proposed Madingley Road West Access	19,311	High	21,109	High	22,859	High
Link 3.6 – Madingley Road – East of Proposed High Cross Access	15,573	Medium	17,207	High	18,634	High
Link 3.7 – Madingley Road – East of JJ Thomson Avenue	17,085	High	18,642	High	19,886	High
Link 3.8 – Madingley Road – East of Clerk Maxwell Road	16,805	High	18,416	High	19,660	High
Link 3.9 – Madingley Road – East of Storey's Way	15,112	Medium	17,000	High	18,213	High
Link 3.10 - Madingley Road – East of Grange Road	15,112	Medium	16,928	High	18,123	High
Link 3.11 – Madingley Road – West of Queen's Road / Northampton Street	16,317	High	18,806	High	19,660	High
Link 3.12 – Northampton Street – West of Pound Hill	13,706	Medium	15,725	Medium	16,664	High
Link 4.0 – Huntingdon Road – West of Proposed NWC HRW Access	10,644	Medium	13,874	Medium	15,410	Medium
Link 4.1 – Huntingdon Road – South East of Grange Drive	10,644	Medium	11,746	Medium	13,057	Medium
Link 4.2 – Huntingdon Road – East of NWC HRW Access	14,955	Medium	20,294	High	22,367	High
Link 4.3 – Huntingdon Road – East of NIAB Access	17,671	High	23,062	High	25,215	High
Link 4.4 – Huntingdon Road – East of Storey's Way	16,411	High	21,790	High	23,882	High
Link 6.0 – Queen's Road – North of West Road	14,928	Medium	15,788	Medium	16,508	High
Link 9.0 – Storey's Way – between Madingley Road and Huntingdon Road	3,215	Negligible	2,800	Negligible	2,825	Negligible
Link 10.0 – Girton Road – North of Huntingdon Road	5,019	Low	5,446	Low	5,535	Low
Link 12.1 – High Cross Access to Madingley Road	2,223	Negligible	1,750	Negligible	1,750	Negligible
Link 12.2 – JJ Thomson Avenue Access to Madingley Road	2,289	Negligible	2,365	Negligible	2,365	Negligible
Link 12.3 – Clerk Maxwell Road – South of Car Park Access	322	Negligible	312	Negligible	312	Negligible
Link 12.4 – Clerk Maxwell Road – North of Car Park Access	851	Negligible	802	Negligible	802	Negligible

Baseline Driver Delay

10.5.7 The Transport Assessment considers that the local network operates towards capacity in 2016 during the network peak hours.

10.5.8 As the junctions along Madingley Road, and others across the network, are operating close to capacity during the peak hours, some Driver Delay would be expected at these limited peak hour times – albeit that these junctions would operate within capacity throughout the significant majority of the day.

10.5.9 Whilst the above assessment suggests there is some driver delay during the peak periods across the study area, taking into account conditions across a full day, only limited Driver Delay is experienced in normal operating conditions.

Baseline pedestrian and cyclist delay

10.5.10 The level of existing pedestrian delay is assumed to broadly reflect the severance as described above – i.e., that there would be limited pedestrian delay experienced within the built-up areas where there is pedestrian activity.

10.5.11 There are reasonable crossing facilities for pedestrians and cyclists to use across the area – this would assist in minimising delay on these routes. Pedestrian delay is therefore slight / negligible.

Baseline pedestrian and cyclist amenity

10.5.12 Pedestrian and cyclist amenity, broadly defined as ‘the relative pleasantness of a journey”, is affected by traffic flows and composition, footway width and the degree of segregation.

10.5.13 Although the strategic highway links (such as the M11, A14, and A428) have high levels of traffic flow and high speeds, there is no pedestrian or cyclist access and there are few / no attractors along these for existing pedestrian and cyclist amenity to be a material consideration.

10.5.14 Although the levels of traffic flows on the local principal highway network are high, existing pedestrian and cyclist amenity within Cambridge is good due to the quality of the footway and cycleway provision, the alternative off-road routes, the frequency of crossing facilities, the limited heavy vehicle proportions, and the relatively controlled vehicle speeds.

Baseline fear and intimidation

10.5.15 The existing levels of fear and intimidation on the road network surrounding the Site are also detailed in Table A6.2.1 contained in Appendix 10.2. Table 10.12 summarises the baseline fear and intimidation for the three assessment years. There is currently no Fear and Intimidation related to the use of public rights of way adjacent to the Site.

Table 10.12 Baseline fear and intimidation (average hourly traffic flows over 18hours)

Receptor	a) Average Hourly Flows Over 18hr Day			b) Total 18hr HV Flows			c) Traffic Speed (mph)	Weighted Assessment of a), b) and c)		
	2016	2021	2031	2016	2021	2031		2016	2021	2031
Link 3.2 – Madingley Road on Over Bridge M11	979	1,035	1,136	1,010	1,068	1,171	40	Low	Low	Low
Link 3.3 – Madingley Road between M11 On Slip – Proposed Madingley Road West Access	1,117	1,221	1,322	737	806	873	40	Low	Low	Low
Link 3.6 – Madingley Road – East of Proposed High Cross Access	901	995	1,078	595	657	712	40	Low	Low	Low
Link 3.7 – Madingley Road – East of JJ Thomson Avenue	988	1,078	1,150	652	712	759	30	Low	Low	Low
Link 3.8 – Madingley Road – East of Clerk Maxwell Road	972	1,065	1,137	642	703	751	30	Low	Low	Low
Link 3.9 – Madingley Road – East of Storey’s Way	874	983	1,053	577	649	696	30	Low	Low	Low
Link 3.10 - Madingley Road – East of Grange Road	874	979	1,048	577	646	692	30	Low	Low	Low
Link 3.11 – Madingley Road – West of Queen’s Road / Northampton Street	944	1,088	1,137	623	718	751	30	Low	Low	Low
Link 3.12 – Northampton Street – West of Pound Hill	793	909	964	523	601	636	30	Low	Low	Low
Link 4.0 – Huntingdon Road – West of Proposed NWC HRW Access	615	802	891	406	530	588	60	Low	Low	Low
Link 4.1 – Huntingdon Road – South East of Grange Drive	615	679	435	406	449	499	30	Low	Low	Low
Link 4.2 – Huntingdon Road – East of NWC HRW Access	865	1,174	1,293	571	775	854	30	Low	Low	Low
Link 4.3 – Huntingdon Road – East of NIAB Access	1,022	1,334	1,458	675	881	963	30	Low	Low	Low
Link 4.4 – Huntingdon Road – East of Storey’s Way	949	1,260	1,381	627	832	912	30	Low	Low	Low
Link 6.0 – Queen’s Road – North of West Road	863	913	955	570	603	630	30	Low	Low	Low
Link 9.0 – Storey’s Way – between Madingley Rd and Huntingdon Road	188	164	165	165	143	145	20	Negligible	Negligible	Negligible
Link 10.0 – Girton Road – North of Huntingdon Road	294	319	324	257	279	283	20	Negligible	Negligible	Negligible
Link 12.1 – High Cross Access to Madingley Road	160	126	126	191	151	151	25	Negligible	Negligible	Negligible
Link 12.2 – JJ Thomson Avenue Access to Madingley Road	165	170	170	197	204	204	25	Negligible	Negligible	Negligible
Link 12.3 – Clerk Maxwell Road – South of Car Park Access	23	22	22	28	26	26	30	Negligible	Negligible	Negligible
Link 12.4 – Clerk Maxwell Road – North of Car Park Access	61	56	56	73	67	67	30	Negligible	Negligible	Negligible

Existing accidents and safety

10.5.16 A Road Safety Review is reported in Section 3.9 of the Transport Assessment, including Personal Injury Collision (PIC - formerly known as Personal Injury Accident – PIA) summary data was obtained from Cambridgeshire County Council for the latest available 5 year period between of 2011 to 2016 for Madingley Road.

10.5.17 The Transport Assessment provides a summary of the PICs (location and nature) and provides an estimate of the likely anticipated number of PICs for similar types of links and junctions to provide a comparison.

10.5.18 Of the collisions on the links within the study area, only the 250m section of Madingley Road link to the west of the Cambridge Road crossroads has a higher than anticipated personal injury collision record. The observed records on all other links were equalled or were lower than that anticipated. A review of these collisions has indicated that these could be speed related, a review of the existing road markings and signings is proposed to alert motorists of this.

10.5.19 The Road Safety assessment has identified three existing road safety issues, the first two for vulnerable road users:

- Madingley Road / Storey's Way priority junction;
- Madingley Road / Grange Road signalised junction; and
- Madingley Road / Cambridge Road crossroads.

10.5.20 Remedial measures are proposed at these locations - further details of these proposed measures are discussed in Section 16 of the Transport Assessment.

10.5.21 The Proposed Development will not result in any detriment to the existing highway safety conditions within the site vicinity.

10.6 Impact Assessment

Construction phase

10.6.1 Further details of the following construction traffic impacts are contained within Section 12 of the Transport Assessment (contained within Appendix 10.1):

- Earthworks;
- On-site Drainage;
- Carriageway Construction; and
- Initial Construction works to a major building.

10.6.2 For the purposes of this assessment it is assumed that the initial construction works for a major building (in this case, the concrete work casting the foundations) would not occur at the same time as the on-site carriageway construction due to the excessive heavy vehicle trip generation characteristics of both operations.

10.6.3 For the purposes of this assessment it is assumed that all heavy vehicle access will be from M11 Junction 13 / Madingley Road – it being assumed that the heavy vehicle movements through the City will be discouraged.

10.6.4 The assumed initial phase peak daily construction traffic flows are summarised in Table 10.13

Table 10.13 Peak daily construction movements

Activity	Max Light Vehicles Movements / day			Max Heavy Vehicles Movements / day			Max Total Vehicles Movements / day		
	In	Out	Tot	In	Out	Tot	In	Out	Tot
Earthworks	10	10	20	82	82	164	92	92	184
On-Site Drainage	4	4	8	4	4	8	8	8	16
Carriageway construction	6	6	12	60	60	120	66	66	132
Building construction	10	10	20	0	0	0	10	10	20
Total	30	30	60	146	146	292	176	176	352

10.6.5 No links within the study area exceed the 10% or 30% thresholds for total traffic increases but a number of links exceed these thresholds for heavy vehicles. These are detailed in Table 10.14.

Table 10.14 Traffic flow increases due to construction traffic

Link	Base 2016 Daily Flow (24 hour, 7 day two-way flows)		Estimated Daily Construction Traffic (two-way)			Increase	
	All Vehs	Heavy Vehs	Light Vehs	Heavy Vehs	All Vehs	All Vehs	Heavy Vehs
Link 1.3 – M11 J13 off-slip and on-slip	17,265	2,681	6	248	254	1.5%	9.2%
Link 3.2 - Madingley Road on Over Bridge M11	17,000	931	9	168	177	1.0%	18.0%
Link 3.3 - Madingley Road between M11 South bound On Slip - Proposed Madingley Road West Access	19,311	656	12	292	304	1.6%	44.5%
Link 3.4 - Madingley Road - West of P&R Access	19,311	656	12	292	304	1.6%	44.5%
Link 3.5 - Madingley Road - East of P&R Access	17,835	606	12	292	304	1.7%	48%
Link 3.6 - Madingley Road - East of Proposed High Cross Access	15,573	529	12	292	304	2.0%	55.2%
Link 3.7 – Madingley Road – East of JJ Thomson Avenue	17,085	581	48	0	48	0.3%	0.0%
Link 3.8 – Madingley Road – East of Clerk Maxwell Road	16,805	571	48	0	48	0.3%	0.0%

10.6.6 Table 10.15 provides the assessment for construction phase transport impacts.

Table 10.15 Construction phase transport effects

Baseline		Impact assessment				
Receptor	**Sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Link 3.2 - Madingley Road on Over Bridge M11 (Drivers along Madingley Road, pedestrians and cyclists travelling along Madingley Road)	Low	Total 352 daily one-way (176 two-way) vehicle movements due to construction traffic for plant, materials, and staff deliveries and the removal of construction waste and excess cut material. Additional traffic flows caused by construction traffic could result in increased severance; driver delay; pedestrian and cyclist delay, fear and intimidation, and reduced pedestrian and cycling amenity	Hours of operation and delivery routes to and from Site will be agreed with the local highways authority and specified in the Construction Environment Management Plan (CEMP)	Negligible	The All Vehicle Construction impact assessment results show that the highest impact would be no more than 0.4%. As such, there are no links experiencing increases exceeding the assessment magnitude threshold of either 30%, or 10% in any sensitive areas. The daily percentage impact for Heavy Vehicles on Link 3.6 Madingley Road to the East of the High Cross Access peaks at 55% - significantly higher than the increase in All Vehicle traffic flows (peaking at 2%). However, there are no receptors with sensitivity greater than Low at this location, nor is the increase in heavy vehicle flow more than a doubling (refer to the thresholds identified in Section 6.3), such that there would be no discernible effect on Severance, Driver Delay, Pedestrian Delay, Pedestrian Amenity, Fear and Intimidation, Road Safety and Hazardous Loads associated with construction activities. In all cases, the magnitude of Construction daily flow increases – be it All Vehicle or Heavy Vehicle - is Negligible, and therefore the significance of effect for the impacts assessed within the chapter for Construction movements is also Negligible. Full details of the assignment of the construction traffic are detailed in Section 12 of the Transport Assessment	Negligible **Not significant**
Link 3.3 – Madingley Road between M11 On Slip – Proposed Madingley Road West Access (Drivers along Madingley Road, pedestrians and cyclists travelling along Madingley Road)	Low			Negligible		Negligible **Not significant**
Link 3.4 – Madingley Road – West of P&R Access (Drivers along Madingley Road, pedestrians and cyclists travelling along Madingley Road)	Low			Negligible		Negligible **Not significant**
Link 3.5 – Madingley Road – East of P&R Access (Drivers along Madingley Road, pedestrians and cyclists travelling along Madingley Road)	Low			Negligible		Negligible **Not significant**
Link 3.6 – Madingley Road – East of Proposed High Cross Access (Drivers along Madingley Road, pedestrians and cyclists travelling along Madingley Road)	Low			Negligible		Negligible **Not significant**

Operational phase

Potential Effects in 2021

10.6.7 Table 10.16 shows the predicted severance levels in 2021. Links 6.0 and 12.1 are predicted to increase in Severance magnitude, the former due to a minor increase in flow resulting in an increase of one Severance threshold from Medium to High, the latter increasing by one from Negligible to Low.

Table 10.16 Predicted severance in 2021

Receptor	Baseline		Proposed Development	
	Base traffic flow	**Severance**	**Base traffic flow**	**Severance**
Link 3.2 – Madingley Road on Over Bridge M11	17,976	High	19,150	High
Link 3.3 – Madingley Road between M11 On Slip – Proposed Madingley Road West Access	21,109	High	22,611	High
Link 3.6 – Madingley Road – East of Proposed High Cross Access	17,207	High	21,293	High
Link 3.7 – Madingley Road – East of JJ Thomson Avenue	18,642	High	20,604	High
Link 3.8 – Madingley Road – East of Clerk Maxwell Rd	18,416	High	21,438	High
Link 3.9 – Madingley Road – East of Storey's Way	17,000	High	20,230	High
Link 3.10 - Madingley Road – East of Grange Road	16,928	High	20,040	High
Link 3.11 – Madingley Road – West of Queen's Road / Northampton Street	18,806	High	19,223	High
Link 3.12 – Northampton Street – West of Pound Hill	15,725	Medium	15,793	Medium
Link 4.0 – Huntingdon Rd – West of Proposed NWC HRW Access	13,874	Medium	15,840	Medium
Link 4.1 – Huntingdon Road – South East of Grange Drive	11,746	Medium	11,613	Medium
Link 4.2 – Huntingdon Road – East of NWC HRW Access	20,294	High	19,716	High
Link 4.3 – Huntingdon Road – East of NIAB Access	23,062	High	22,315	High
Link 4.4 – Huntingdon Road – East of Storey's Way	21,790	High	20,891	High
Link 6.0 – Queen's Road – North of West Rd	15,788	Medium	16,982	High

Receptor	Baseline		Proposed Development	
	Base traffic flow	Severance	Base traffic flow	Severance
Link 9.0 – Storey's Way – between Madingley Road and Huntingdon Road	2,800	Negligible	2,799	Negligible
Link 10.0 – Girton Road – North of Huntingdon Road	5,446	Low	5,476	Low
Link 12.1 – High Cross Access to Madingley Road	1,750	Negligible	5,425	Low
Link 12.2 – JJ Thomson Ave Access to Madingley Road	2,365	Negligible	2,347	Negligible
Link 12.3 – Clerk Maxwell Road – South of Car Park Access	312	Negligible	102	Negligible
Link 12.4 – Clerk Maxwell Road – North of Car Park Access	802	Negligible	1,613	Negligible

10.6.8 Table 10.17 shows the predicted fear and intimidation levels with and without the Proposed Development in 2021. The magnitude of fear and intimidation would not increase for any links.

Table 10.17 Fear and intimidation in 2021

Receptor	Baseline				Proposed Development			
	a) Average Hourly Flows Over 18hr Day	b) Total 18hr HV Flows	c) Traffic Speed (mph)	Weighted Assessment of a), b) and c)	a) Average Hourly Flows Over 18hr Day	b) Total 18hr HV Flows	c) Traffic Speed (mph)	Weighted Assessment of a), b) and c)
Link 3.2 – Madingley Road on Over Bridge M11	1,035	1,068	40	Low	1,136	1,171	40	Low
Link 3.3 – Madingley Road between M11 On Slip – Proposed Madingley Road West Access	1,221	1,068	40	Low	1,308	863	40	Low
Link 3.6 – Madingley Road – East of Proposed High Cross Access	995	657	40	Low	1,231	813	40	Low
Link 3.7 – Madingley Road – East of JJ Thomson Avenue	1,078	712	30	Low	1,191	787	30	Low
Link 3.8 – Madingley Road – East of Clerk Maxwell Road	1,065	703	30	Low	1,240	819	30	Low
Link 3.9 – Madingley Road – East of Storey's Way	983	649	30	Low	1,170	773	30	Low
Link 3.10 - Madingley Road – East of Grange Road	979	646	30	Low	1,159	765	30	Low
Link 3.11 – Madingley Road – West of Queen's Road / Northampton Street	1,088	718	30	Low	1,112	734	30	Low
Link 3.12 – Northampton Street – West of Pound Hill	909	601	30	Low	913	603	30	Low
Link 4.0 – Huntingdon Road – West of Proposed NWC HRW Access	802	530	60	Low	916	605	60	Low
Link 4.1 – Huntingdon Road – South East of Grange Drive	679	449	30	Low	672	443	30	Low
Link 4.2 – Huntingdon Road – East of NWC HRW Access	1,174	775	30	Low	1,140	753	30	Low
Link 4.3 – Huntingdon Road – East of NIAB Access	1,334	881	30	Low	1,290	852	30	Low
Link 4.4 – Huntingdon Road – East of Storey's Way	1,260	832	30	Low	1,208	798	30	Low

Receptor	Baseline				Proposed Development			
	a) Average Hourly Flows Over 18hr Day	b) Total 18hr HV Flows	c) Traffic Speed (mph)	Weighted Assessment of a), b) and c)	a) Average Hourly Flows Over 18hr Day	b) Total 18hr HV Flows	c) Traffic Speed (mph)	Weighted Assessment of a), b) and c)
Link 6.0 – Queen's Road – North of West Road	913	603	30	Low	982	649	30	Low
Link 9.0 – Storey's Way – between Madingley Road and Huntingdon Road	164	143	20	Negligible	164	143	20	Negligible
Link 10.0 – Girton Road – North of Huntingdon Road	319	279	20	Negligible	320	280	20	Negligible
Link 12.1 – High Cross Access to Madingley Road	126	151	25	Negligible	391	467	25	Negligible
Link 12.2 – JJ Thomson Avenue Access to Madingley Road	170	204	25	Negligible	169	202	25	Negligible
Link 12.3 – Clerk Maxwell Road – South of Car Park Access	22	26	30	Negligible	7	8	30	Negligible
Link 12.4 – Clerk Maxwell Road – North of Car Park Access	56	27	30	Negligible	112	134	30	Negligible

10.6.9 Table 10.18 shows the environmental impact assessment for operational phase effects for the first phase of the development in 2021.

Table 10.18 Operational phase transport effects in 2021

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
• Colleges on Storey's Way (link 9.0) • Colleges on Huntingdon Road (links 4.1, 4.4) • Church on Huntingdon Road (link 4.4)	High High Low	Increased traffic flows along the following affected links could result in an increase in: Severance; Fear and Intimidation; and Pedestrian delay.	Provisions within the transport strategy to i) reduce new vehicle trips; ii) review existing pedestrian and cyclist infrastructure	Negligible	Baseline severance and fear and intimidation in 2021 is predicted to range from high for receptors along Huntingdon Road to negligible for receptors along Storey's Way. Once the Initial Phase of the Proposed Development is operational in 2021 whilst traffic flows are predicted to increase along all of these links, for all these receptors the fear / intimidation and severance magnitude will remain unchanged. Based on the change in traffic flow due to the addition of cumulative development and Proposed Development traffic flow changes, there is unlikely to be a perceptible change in the level of pedestrian delay. As such, the likely significance of effect for pedestrian delay is Negligible.	Negligible **Not significant**
• Residents living on Madingley Road (links 3.6, 3.7, 3.8, 3.9, 3.10) • Residents living at Northampton Street (link 3.12) • Employees working at West Cambridge (links 12.1, 12.2)	Low	Increased traffic flows could result in an increase in Severance for residents and workers along the affected links.	Provisions within the transport strategy to: i) reduce new vehicle trips; ii) enhance pedestrian and cyclist infrastructure.	Low adverse	Baseline severance in 2021 is predicted to range from high for receptors along Madingley Road to negligible for receptors along the three roads on-Site and the new access road to north west Cambridge off Huntingdon Road. Once the first phase of the Proposed Development is operational in 2021 traffic flows are predicted to increase along all of these links. For most receptors the severance magnitude will remain unchanged. For receptors along High Cross on link 12.1 traffic flows will increase by 3,675 vehicles across 24 hours. Whilst this will increase the severance magnitude from negligible to low, the 5,425 AADT is still less than the threshold of 8,000 AADT. Whilst the effect is likely to be noticeable given the proportionate increase against the baseline traffic flows, severance will still be low. Overall the magnitude of impact from increased severance would be low adverse.	Minor adverse **Not significant**

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
• Drivers along Madingley Road (links 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, and 3.11) • Drivers along Northampton Street (link 3.12) • Drivers along Huntingdon Road (links 4.0, 4.1, 4.2, 4.3, 4.4) • Drivers along High Cross Road (link 12.1) • Drivers along JJ Thomson Avenue (link 12.2) • Drivers along Clerk Maxwell Road (link 12.3, 12.4)	Low	Increase in Driver Delay at junctions and road links caused by increased use of the local road network by drivers travelling to and from the Proposed Development.	Provisions within the transport strategy to reduce new vehicle trips, and - only where shown to be necessary – minor enhancements to the local junction infrastructure.	Negligible	Whilst the results of the 2021 junction capacity assessments for the Proposed Development shows the network generally with conditions at capacity in peak periods, there would be limited levels of delay for drivers when considered across the full 24 hour day. Overall the magnitude of change in daily flows as a consequence of the addition of Cumulative Development and Development traffic – considered to be the difference between 2016 Base and 2021 scenarios - is Negligible and the sensitivity of the links and junctions to increases in daily flow is Low - therefore the overall significance of effect for driver delay is Negligible.	Negligible **Not significant**
• Pedestrians and cyclists travelling along Madingley Road (links 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, and 3.11) • Pedestrians and cyclists travelling along Northampton Street (link 3.12) Pedestrians and cyclists travelling along Huntingdon Road (links 4.1, 4.2, 4.3, 4.4) • Pedestrians and cyclists travelling along High Cross Road (link 12.1) • Pedestrians and cyclists travelling along JJ Thomson Avenue (link 12.2) • Pedestrians and cyclists travelling along Clerk Maxwell Road (link 12.3, 12.4)	Low	Increase in Pedestrian Delay as a result of an increase in traffic travelling to and from the Proposed Development.	Provisions within the transport strategy to i) reduce new vehicle trips; ii) enhance pedestrian and cyclist infrastructure.	Negligible	Based on the change in pedestrian severance category due to the addition of cumulative development and Proposed Development traffic flow changes, there is unlikely to be a perceptible change in the level of pedestrian delay. As such, the likely significance of effect for pedestrian delay is Negligible.	Negligible **Not significant**
		Changes to Pedestrian Amenity - the relative pleasantness of pedestrian and cyclist journeys - as a result of changes in traffic.	Provisions within the transport strategy to i) reduce new vehicle trips; ii) enhance pedestrian and cyclist infrastructure.	Negligible	The relevant guidance suggests a tentative threshold for assessing the significance of changes in pedestrian amenity of where traffic flow is halved or doubled. There are three links to consider: Link 12.4 - Clerk Maxwell Road North of Car Park Access - experiences an increase of 100% - based on a further 811 vehicles per day – whilst Link 12.3 – Clerk Maxwell South of Car Park Access – decreases to 32% - based on a reduction of 210 vehicles per day. Whilst the former impact, being for a distance of 60m, would be significant, this would be offset by the benefit to pedestrians and cyclists provided along the remaining 420m length of Clerk Maxwell Road – will not result in any discernible adverse change in pedestrian amenity; Link 12.1 – High Cross Access. Whilst this experiences an increase of 200%, this relates to the low initial flow reflecting that development of this area has not progress far currently. As High Cross is formed with wide grass verges and quality footway / cycleways, will not result in any discernible change in pedestrian amenity. There are no other existing off-site links forecast to experience a doubling of traffic flow with the addition of Cumulative Development and Development traffic – indeed whilst most links experience minimal change, all other increases are well below 30%. Within the Site, the traffic flow changes arising from the Proposed Development will not result in any discernible change in pedestrian amenity, and that the significance of effect on Pedestrian Amenity is therefore Negligible.	Negligible **Not significant**
Pedestrians and cyclists	Low	Changes in traffic volume, composition and speed resulting in an increase in fear and intimidation to pedestrians and cyclists.	Provisions within the transport strategy to i) reduce new vehicle trips; ii) enhance pedestrian and cyclist infrastructure, and iii) improve the amenity of pedestrian and cyclist routes along popular corridors.	Negligible	The Cumulative Development will result in an increase in overall and heavy vehicle traffic flows on most of the assessed links with sensitive receptors, with a maximum increase of 265 overall vehicles per average hour and 316 heavy vehicles over 18 hours for link 12.1. Speeds are not predicted to change for any of the links. The Proposed Development will not change the magnitude of fear and intimidation for any of the receptors and the overall effect will be negligible.	Negligible **Not significant**

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
• Drivers along Madingley Road (links 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, and 3.11) • Pedestrians and cyclists travelling along Madingley Road (links 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, and 3.11) • Drivers along Northampton Street (link 3.12) • Pedestrians and cyclists travelling along Northampton Street (link 3.12) • Drivers along Huntingdon Road (links 4.0, 11.2) • Pedestrians and cyclists travelling along Huntingdon Road (links 4.0, 11.2) • Drivers along the north west Cambridge access roads from Madingley Road and Huntingdon Road (links 11.1 and 11.2) • Pedestrians and cyclists along the north west Cambridge access roads from Madingley Road and Huntingdon Road (links 11.1 and 11.2) • Drivers along High Cross Road (link 12.1) • Pedestrians and cyclists travelling along High Cross Road (link 12.1) • Drivers along JJ Thomson Avenue (link 12.1) • Pedestrians and cyclists travelling along JJ Thomson Avenue (link 12.1) • Drivers along Clerk Maxwell Road (link 12.3) • Pedestrians and cyclists travelling along Clerk Maxwell Road (link 12.3)	Low	Changes in traffic flows could result in a change on personal injury collision rates.	Provisions within the transport strategy to provide road safety measures at identified blackspots.	Negligible	The additional traffic flows on the network resulting from the West Cambridge Development would be unlikely to have any significant effect on existing personal injury collision rates. The overall significance of effect for Highway Safety is therefore Negligible.	Negligible **Not significant**

Potential Effects in 2031

10.6.10 Table 10.19 shows the predicted severance levels in 2031. Links 4.0 and 12.2 are predicted to increase in severance magnitude. There are no receptors along link 4.0 so this link has not been considered further in the impact assessment for severance.

Table 10.19 Predicted severance in 2031

Receptor	Baseline		Proposed Development	
	Base traffic flow	Severance	Base traffic flow	Severance
Link 1.3 – M11 J13 off-slip and on-slip	21,742	High	24,865	High
Link 3.2 – Madingley Road on Over Bridge M11	19,724	High	23,053	High
Link 3.3 – Madingley Rd between M11 On Slip – Proposed Madingley Road West Access	22,859	High	27,397	High
Link 3.6 – Madingley Road – East of Proposed High Cross Access	18,634	High	22,976	High
Link 3.7 – Madingley Road – East of JJ Thomson Avenue	19,886	High	25,098	High
Link 3.8 – Madingley Road – East of Clerk Maxwell Road	19,660	High	26,554	High
Link 3.9 – Madingley Road – East of Storey's Way	18,213	High	25,316	High
Link 3.10 - Madingley Road – East of Grange Road	18,123	High	25,036	High
Link 3.11 – Madingley Road – West of Queen's Road / Northampton Street	19,660	High	22,149	High
Link 3.12 – Northampton Street – West of Pound Hill	16,664	High	18,052	High
Link 4.0 – Huntingdon Road – West of Proposed NWC HRW Access	15,410	Medium	20,434	High
Link 4.1 – Huntingdon Road – South East of Grange Drive	13,057	Medium	12,870	Medium
Link 4.2 – Huntingdon Road – East of NWC HRW Access	22,367	High	22,197	High
Link 4.3 – Huntingdon Road – East of NIAB Access	25,215	High	24,339	High
Link 4.4 – Huntingdon Road – East of Storey's Way	23,882	High	22,650	High
Link 6.0 – Queen's Road – North of West Road	16,508	High	19,031	High
Link 9.0 – Storey's Way – between Madingley Road and Huntingdon Road	2,825	Negligible	2,817	Negligible
Link 10.0 – Girton Road – North of Huntingdon Road	5,535	Low	5,717	Low
Link 12.1 – High Cross Access to Madingley Road	1,750	Negligible	5,798	Negligible
Link 12.2 – JJ Thomson Ave Access to Madingley Road	2,365	Negligible	4,599	Low
Link 12.3 – Clerk Maxwell Road – South of Car Park Access	312	Negligible	102	Negligible
Link 12.4 – Clerk Maxwell Rd – North of Car Park Access	802	Negligible	1,667	Negligible

10.6.11 Table 10.20 shows the predicted fear and intimidation levels with and without the Proposed Development in 2031. The magnitude of fear and intimidation would not increase for any links.

Table 10.20 Fear and intimidation at 2031

Receptor	Baseline				Proposed Development			
	a) Average Hourly Flows Over 18hr Day	b) Total 18hr HV Flows	c) Traffic Speed (mph)	Weighted Assessment of a), b) and c)	a) Average Hourly Flows Over 18hr Day	b) Total 18hr HV Flows	c) Traffic Speed (mph)	Weighted Assessment of a), b) and c)
Link 1.3 – M11 J13 off-slip and on-slip	1,210	3,419	70	High	1,384	3,911	70	High
Link 3.2 – Madingley Road on Over Bridge M11	1,136	1,171	40	Low	1,327	1,369	40	Low
Link 3.3 – Madingley Road between M11 On Slip – Proposed Madingley Road West Access	1,332	873	40	Low	1,584	1,046	40	Low
Link 3.6 – Madingley Road – East of Proposed High Cross Access	1,078	712	40	Low	1,329	877	40	Low
Link 3.7 – Madingley Road – East of JJ Thomson Avenue	1,150	759	30	Low	1,451	958	30	Low
Link 3.8 – Madingley Road – East of Clerk Maxwell Road	1,137	751	30	Low	1,536	1,014	30	Low
Link 3.9 – Madingley Road – East of Storey's Way	1,053	696	30	Low	1,464	967	30	Low
Link 3.10 - Madingley Road – East of Grange Road	1,048	692	30	Low	1,448	956	30	Low
Link 3.11 – Madingley Road – West of Queen's Road / Northampton Street	1,137	751	30	Low	1,281	846	30	Low
Link 3.12 – Northampton Street– West of Pound Hill	964	636	30	Low	1,044	689	30	Low
Link 4.0 – Huntingdon Road – West of Proposed NWC HRW Access	891	588	60	Low	1,182	780	60	Low
Link 4.1 – Huntingdon Road – South East of Grange Drive	755	499	30	Low	744	492	30	Low
Link 4.2 – Huntingdon Road – East of NWC HRW Access	1,293	854	30	Low	1,284	848	30	Low
Link 4.3 – Huntingdon Road – East of NIAB Access	1,458	963	30	Low	1,407	929	30	Low
Link 4.4 – Huntingdon Road – East of Storey's Way	1,381	912	30	Low	1,310	865	30	Low
Link 6.0 – Queen's Road – North of West Road	955	630	30	Low	1,101	727	30	Low
Link 9.0 – Storey's Way – between Madingley Road and Huntingdon Road	165	145	20	Negligible	165	144	20	Negligible
Link 10.0 – Girton Road – North of Huntingdon Road	324	283	30	Negligible	335	293	30	Negligible
Link 12.1 – High Cross Access to Madingley Road	126	151	20	Negligible	418	499	20	Negligible
Link 12.2 – JJ Thomson Avenue Access to Madingley Road	170	204	25	Negligible	332	396	25	Negligible
Link 12.3 – Clerk Maxwell Road.	22	26	25	Negligible	7	8	30	Negligible
Link 12.4 – Clerk Maxwell Road – North of Car Park Access	56	67	30	Negligible	116	139	30	Negligible

10.6.12 Table 10.21 shows the environmental impact assessment for operational phase effects for the first phase of the development in 2031.

Table 10.21 Operational phase transport effects in 2031

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
• Colleges on Storey's Way (link 9.0) • Colleges on Huntingdon Road (links 4.1, 4.4) • Church on Huntingdon Road (link 4.4)	High High Low	Increased traffic flows along the following affected links could result in an increase in: Severance; Fear and Intimidation; and Pedestrian delay.	Provisions within the transport strategy to i) reduce new vehicle trips; ii) review existing pedestrian and cyclist infrastructure	Negligible	Baseline severance and fear / intimidation in 2031 is predicted to range from high for receptors along Huntingdon Road to negligible for receptors along Storey's Way. Once the Proposed Development is fully built out and operational in 2031, traffic flows are predicted to increase along all of these links. For all these receptors, the fear / intimidation and severance magnitude will remain unchanged. Based on the change in flow due to the addition of cumulative development and Proposed Development traffic flow changes, there is unlikely to be a perceptible change in the level of pedestrian delay. As such, the likely significance of effect for pedestrian delay is Negligible.	Negligible **Not significant**
• Residents living on Madingley Road (links 3.6, 3.7, 3.8, 3.9, 3.10) • Residents living at Northampton Street (link 3.12) Employees working at West Cambridge (links 12.1, 12.2)	Low	Increased traffic flows could result in an increase in Severance for residents and workers along the affected links.	Adaptive Phased Approach to long-term transport mitigation.	Low adverse	Baseline severance in 2031 is predicted to range from high for receptors along Madingley Road, Northampton Street and Huntingdon Road (between the East of NIAB access and the East of Storey's way) to negligible for receptors along the three roads on-Site. Once the Proposed Development is fully built out and operational in 2031, traffic flows are predicted to increase along all of these links. For link 4.0 – Huntingdon Road, west of the NWC HRW access, whilst the severance has increased from medium to high, the numbers of pedestrians and cyclists is low, but connectivity across Huntingdon Road will be improved by the delivery of the pedestrian / cyclist crossing at this junction as part of the NWC Proposals. In addition, and although not identified as a change in severance, there will be an increase in traffic volumes along Madingley Road affecting links 3.2 to 3.11. The 2031 Baseline Severance along Madingley Road is predicted to be high and there are a number of mitigation measures already in place including centre refuges and crossings. The effect of severance on residents and employees along Madingley Road is unlikely to be significant. Overall the magnitude of impact from increased severance would be permanent low adverse.	Minor adverse **Not significant**
• Drivers along Madingley Road (links 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, and 3.11) • Drivers along Northampton Street (link 3.12) • Drivers along Huntingdon Road (links 4.0) • Drivers along High Cross Road (link 12.1) • Drivers along JJ Thomson Avenue (link 12.2) • Drivers along Clerk Maxwell Road (link 12.3)	Low	Increase in Driver Delay at junctions and road links caused by increased use of the local road network by drivers travelling to and from the Proposed Development.	Adaptive Phased Approach to long term transport mitigation.	Negligible	The future junction capacity assessments for 2031 for the Proposed Development will be required to show the proposed local network would operate within absolute capacity in peak periods. As such, there would be limited levels of delay for drivers across the day. Further mitigation measures would be considered where the impact of West Cambridge is considered significant. The magnitude of change in daily flows as a consequence of the Proposed Development would be Negligible. The overall significance of effect for Driver Delay is also Negligible.	Negligible **Not significant**
• Pedestrians and cyclists travelling along Madingley Road (links 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, and 3.11) • Pedestrians and cyclists travelling along Northampton Street (link 3.12)	Low	Increase in Pedestrian Delay as a result of an increase in traffic travelling to and from the Proposed Development.	Adaptive Phased Approach to long term transport mitigation.	Negligible	Based on the change in pedestrian severance category due to the addition of cumulative development and Proposed Development traffic flow changes, there is unlikely to be a perceptible change in the level of pedestrian delay. As such, the likely significance of effect for pedestrian delay is Negligible.	Negligible **Not significant**

Baseline		**Impact assessment**				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
• Pedestrians and cyclists travelling along Huntingdon Road (links 4.1, 4.2, 4.3 and 4.4) • Pedestrians and cyclists travelling along High Cross Road (link 12.1) • Pedestrians and cyclists travelling along JJ Thomson Avenue (link 12.2) • Pedestrians and cyclists travelling along Clerk Maxwell Road (link 12.3, 12.4)	Low	Changes to Pedestrian Amenity - the relative pleasantness of pedestrian and cyclist journeys as a result of changes in traffic.	Provisions within the transport strategy to improve the amenity of pedestrian and cyclist routes.	Negligible	The relevant guidance suggests a tentative threshold for assessing the significance of changes in pedestrian amenity of where traffic flow is halved or doubled. There are four links to consider: Link 12.4 - Clerk Maxwell Road North of Car Park Access - experiences an increase of 108% - based on a further 865 vehicles per day, whilst Link 12.3 – Clerk Maxwell South of Car Park Access – decreases by 67% - based on a reduction of 210 vehicles per day. Whilst the former impact, being for a distance of 60m, would be significant, this would be offset by the benefit to pedestrians and cyclists provided along the remaining 420m length of Clerk Maxwell Road – will not result in any discernible adverse change in pedestrian amenity. Link 12.2 – JJ Thomson Ave Access to Madingley Rd experience an increase of 94% - based on a further 2234 vehicles per day. This relates to the low initial flow reflecting that development of this area has not progress far currently. As JJ Thomson Avenue is formed with wide grass verges and quality footway / cycleways, will not result in any discernible change in pedestrian amenity Link 12.1 – High Cross Access. Whilst this experiences an increase of 231%, based on a further 4,048 vehicles per day, this relates to the low initial flow reflecting that development of this area has not progress far currently. As High Cross is formed with wide grass verges and quality footway / cycleways, will not result in any discernible change in pedestrian amenity. There are no other existing off-site links forecast to experience a doubling of traffic flow with the addition of Cumulative Development and Development traffic – most increases are well below 30%. Within the Site, as such, the traffic flow changes arising from the Proposed Development will not result in any discernible change in pedestrian amenity, and that the impact of magnitude on Pedestrian Amenity is therefore Negligible.	Negligible **Not significant**
Pedestrians and cyclists	Low	Changes in traffic volume, composition and speed resulting in an increase in fear and intimidation to pedestrians and cyclists.	Adaptive Phased Approach to long term transport mitigation. Provisions within the transport strategy to improve the amenity of pedestrian and cyclist routes	Negligible	The Cumulative Development will result in an increase in overall and heavy vehicle traffic flows on all of the assessed links with sensitive receptors, with a maximum increase of 411 overall vehicles per average hour and 271 heavy vehicles over 18 hours for link 3.9. Speeds are not predicted to change for any of the links. The Proposed Development will not change the magnitude of impact to fear and intimidation for any of the receptors and the overall effect will be negligible.	Negligible **Not significant**

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
• Drivers along Madingley Road (links 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, and 3.11) • Pedestrians and cyclists travelling along Madingley Road (links 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, and 3.11) • Drivers along Northampton Street (link 3.12) • Pedestrians and cyclists travelling along Northampton Street (link 3.12) • Drivers along Huntingdon Road (links 4.0, 4.1, 4.2, 4.3 and 4.4) • Pedestrians and cyclists travelling along Huntingdon Road (links 4.1, 4.2, 4.3 and 4.4) • Drivers along High Cross Road (link 12.1) • Pedestrians and cyclists travelling along High Cross Road (link 12.) • Drivers along JJ Thomson Avenue (link 12.2) • Pedestrians and cyclists travelling along JJ Thomson Avenue (link 12.2) • Drivers along Clerk Maxwell Road (link 12.3, 12.4) • Pedestrians and cyclists travelling along Clerk Maxwell Road (link 12.3, 12.4)	Low	Changes in traffic flows could result in a change on personal injury collision rates.	Adaptive Phased Approach to long term transport mitigation.	Negligible	The additional traffic flows on the network resulting from the West Cambridge Development would be unlikely to have any significant effect on existing personal injury collision rates, although the number of personal injury collisions would be likely to increase as a function of additional traffic flows on these links in 2031. The overall significance of effect for Highway Safety is therefore Negligible.	Negligible **Not significant**

10.7 Mitigation measures

Construction phase

10.7.1 A Construction Environment Management Plan (CEMP) will be implemented by the developer, approved by Cambridge City Council prior to construction commencing, and implemented by all contractors associated with the Proposed Development. This document will identify the appropriate hours of operation and routes to be used by construction vehicles travelling to and from the Site. Specific mitigation which will be included within the CEMP includes:

- Delivery routes will be agreed with the local highways authority and will preferentially access the Site from the M11 Junction 13/ Madingley Road particularly for heavy vehicles; and
- Heavy vehicle movements will not be permitted through Cambridge unless no alternative is available and only once agreement has been sought with the local highway authority.

Operational mitigation for the initial phase of development (2021)

Transport strategy

10.7.2 The mitigation measures to be implemented; to reduce the vehicular trip generation of the Initial Phase of the Proposed Development, to reduce vehicle use on the network, and to manage the effects of the Proposed Development, are:

- The travel demand management strategy, set out in the Framework Travel Plan based on:
  - The benefit of a fully-funded quality FTP;
  - The consequences of the application of "Smarter Choices" guidance to reduce vehicular trip generation from the Proposed Development; and
  - The provision of car parking at a controlled, appropriate level of provision, and the implementation of a car parking management scheme combined with permit provision on a demonstrated needs basis;
- An enhanced public transport strategy. The scale of the Proposed Development means that there will be both a high quantum of demand for public transport, and a number of locations that will need to be connected to West Cambridge. The strategy, detailed within Section 7 of the Transport Assessment, includes:
  - Increased regularity of bus provision;
  - Direct on-site routes;
  - Provision of high quality bus stops (including real time passenger information, and the provision of comprehensive timetable information including network maps and fare details);
  - Bus priority measures to be provided with Selective Vehicle Detection technology at any new traffic signals controlling the entrances to the Site from Madingley Road;
  - Provision of service information and incentive measures to increase patronage; and
  - Promote network ticketing with operators serving West Cambridge, allowing for passengers from destinations other than Cambridge city centre to make journeys on other services and transfer using the same ticket stored on a smartcard, mobile phone or EMV wave and pay card.
- Quality pedestrian and cyclist facilities. The strategy, detailed within Section 6 of the Transport Assessment, includes:
  - Direct, quality North-South footway and cycleway provision across West Cambridge linking between Madingley Road and Coton Path using the Western Access, High Cross, JJ Thomson Avenue and Clerk Maxwell Road.;

- The East - West Shared Space Link to provide the main east - west spine for Pedestrians and Cyclists connecting Clerk Maxwell Road and High Cross with access to a number of plots and lower-hierarchy Cycle routes;
- As with north west Cambridge, all vehicle routes being designed for a 20mph speed limit using passive speed management measures such as constrained widths and the use of shared surface areas. This low-speed environment is primarily to control vehicle speeds, but in so doing will create a safer and more attractive environment for pedestrians and cyclists;
- Footways being provided on both sides of the on-site streets and at the Site Access locations. Controlled crossing points would be provided, and traffic calming measures would be present to reduce traffic speed and to ease pedestrian movement;
- Improved links between West Cambridge and all popular destinations; including to the East, towards the City, and to the north through north west Cambridge. These links will be supported with controlled crossings;
- Provision of high levels of quality cycle parking, at least to the adopted Cambridge Local Plan 2014 minimum cycle parking standards, within private covered, secure, lit and well-located areas at the destinations, as well as further provision through the Development; and
- All major employers being encouraged to provide associated shower and changing room facilities for walkers and cyclists after their journeys.

- Schemes to improve environmental conditions. The strategy, identified in Section 16 of the Transport Assessment, includes:
  - Contributions to affect a lower speed limit than the existing 40mph speed limit locally on Madingley Road – thus providing environmental benefit from existing vehicular movements;
  - Contributions to the necessary Traffic Regulation Orders to implement car parking zones or prohibitions on surrounding streets to minimise inappropriate overspill parking – potentially in the context of providing improved cycle facilities;
  - Measures at three locations to address existing highway safety concerns – especially effecting vulnerable road users;
  - The extension of the SCOOT and MOVA traffic signal optimisation to the proposed traffic signals along Madingley Road – JJ Thomson Avenue and Clerk Maxwell – to control any additional queuing and delays as a consequence of the Proposed Development.
- Guaranteeing funding for potential highway mitigation schemes that could be implemented should the cyclic monitoring strategy identify that conditions deteriorate significantly at:
  - Madingley Road / High Cross junction; and
  - Madingley Road / Clerk Maxwell Road junction.

Operational Mitigation for the Full Development (2031)

10.7.3 At the date of the submission of the Planning Application, there was significant uncertainty regarding:

- Development delivery across the Cambridge Sub Region;
- The associated infrastructure provision necessary to accommodate this level, of growth - particularly relating to:
  - The A14 Huntingdon – Cambridge Enhancement;
  - The Greater Cambridge City Deal transport proposals;
  - Highways England’s currently unpublished proposals for the M11;
  - Other emerging transport proposals – such as improvements to east - west movement;
- The emerging development policy, including that enshrined within the Cambridge Local Plan.

10.7.4 As there may be a degree of variability in future traffic flow projections (which can be attributed to a number of factors including fuel prices, Government policy etc.), this pragmatic mitigation strategy has been formulated which is designed to be resilient to change in conditions by being focused to all sustainable modes, with appropriate levels of mitigation for vehicular traffic. This strategy therefore reflects current planning policy by:

- Reducing and controlling existing and future vehicular trips across the network;
- Improving pedestrian and cyclist infrastructure through the area for the benefit of both the existing and future users;
- Providing financial contributions towards the delivery of public transport services on and off-Site infrastructure; and
- Where necessary, providing measures to preserve and / or enhance capacity on particular links or junctions.

10.7.5 The overall transport strategy for the Proposed Development responds to a number of important national and local objectives. The mitigation provision for the Initial Phase of the Proposed Development is set within the agreed context for the overall transport mitigation strategy for West Cambridge, consisting of:

- A graduated approach – the assessment process reflecting current transport planning policy where travel demand management measures are introduced first, followed by any necessary highway infrastructure measures to mitigate the residual traffic impact; as well as
- An adaptive approach – where, to maintain future flexibility, the proposed mitigation for later phases responds to the quanta of development within the individual phase proposals, the timescales for the delivery, changes in future travel behaviour patterns, emerging transport policy, and the current uncertainty relating to the development and transport infrastructure enhancement proposals.

10.7.6 Acknowledging this situation, as discussed with the Joint Authorities, it is not appropriate to define further mitigation measures at this stage beyond an indicative Initial Phase of development (i.e. over and above the measures described in the Framework Travel Plan and those additional measures envisaged in the 2021 scenario) prior to confirmation of the details of the above. Instead, the Adaptive Phase Approach is proposed, through which a mitigation scheme will be developed at the appropriate time, and ensured through a planning condition, which sets out:

- The mitigation scheme's objectives including the targets it must meet over time;
- The mitigation scheme's parameters;
- The methods of achieving the mitigation scheme's objectives and reviewing and adapting those methods over time to ensure that the objectives are met; and
- A review mechanism to ensure that the achievement of the objectives is kept under review and the methods adapted if further steps prove necessary.

10.7.7 The likely mitigation strategy is anticipated to consist of the following elements:

- To control and reduce vehicle trip generation:
  - provision of appropriate levels of car parking on-site, with delivery phased to reflect development implementation;
  - managing the on-site car parking provision; and
  - review of car parking off-site, offer of further parking control measures if required.
- To preserve conditions:
  - offer contributions to the delivery of a further reduction in the Madingley Road speed limit; and
  - review road safety and promote further local schemes if required.
- To improve conditions for pedestrians and cyclists on-site:
  - quality footway / cycleway infrastructure;
  - high levels of conveniently located quality cycle parking;
  - all major occupiers providing shower and changing room facilities; and
  - managing cycle parking provision.
- To improve conditions for pedestrians and cyclists off-site:
  - providing remedial measures to assist in resolving any identified emerging road safety issues;
  - improved crossing at Eddington Avenue;
  - improved facilities along the Corridor to the City Centre – along Grange Road, West Road, Queen's Green and Silver Street; and
  - contributions to the delivery of a further reduction in the Madingley Road speed limit.
- To enhance Public Transport on-site:
  - provide selected vehicle detection for buses through traffic signal controlled junctions to provide bus priority; and
  - provide information and incentives to the site occupiers.
- Enhanced bus services:
  - Citi 4 - increased frequency to every 10 minutes;
  - Universal – possibly introduce an extended orbital service to Addenbrooke's Hospital; or
  - Arc Service – increased frequency, and possibly extend service further to South Cambridge;
  - review a new variation of the Service B on the Guided Busway.
- Enhancing travel demand management:
  - locate further Car Club vehicles on-site;
  - review cycling initiatives – including cycle pools, cycle buddy, training, discounted equipment; and
  - marketing and promotion.
- To preserve local highway capacity, consider physical interventions:
  - provide localised highway enhancement to accommodate the new Western Access Road junction; and
  - consider further highway mitigations, if required.
- To preserve strategic highway capacity, consider Corridor interventions:
  - work together with the Highway and Planning Authorities to deliver interventions strategically

10.8 Summary

10.8.1 During the construction phase traffic, construction traffic will be controlled through measures specified in the CEMP. This will include reaching an agreement with the local highways authority about delivery routes which will avoid Cambridge city centre. There would be no significant adverse or beneficial transport effects from the Proposed Development during the construction phase.

10.8.2 The first phase of the Proposed Development is anticipated to be operational in 2021.A transport strategy has been produced and this sets out mitigation measures identified as being required through transport modelling and other measures to improve the amenity of pedestrian and cyclist routes. There will be no significant adverse or beneficial transport effects in 2021.

10.8.3 The full Proposed Development will be operational in 2031. Due to uncertainty about other developments in the city and region and the required provision of new or upgraded transport infrastructure it is not possible to specify what mitigation measures might be required. Instead mitigation will be identified and implemented through an Adaptive Phased Approach which will ensure the right measures are implemented at the right time and in the right location. There would be no significant adverse or beneficial transport effects in 2031.

11. Air quality

11.1 Introduction

11.1.1 This chapter updates the air quality assessment in the submitted ES to show the changes resulting from the amended Proposed Development. The air quality assessment requires amending due to the update in the predicted traffic flows. The following sections remain unchanged from the submitted ES and have not been replicated within this document.

- Scope of assessment;
- Relevant legislation and policy;

11.1.2 The following sections require updating to reflect the amended Proposed Development and are presented in this chapter:

- Method of assessment- Operational phase only. Construction phase effects remain unchanged.
- Baseline conditions.
- Impact assessment – Operational phase only. Construction phase effects remain unchanged;
- Mitigation measures;
- Summary.

11.2 Method of assessment

Impact assessment – operational effects

11.2.1 Updated information is provided on the operational effects of the development only where there is a change from the original assessment.

11.2.2 Re-modelling to take revised traffic data into consideration has also included updating the assessment methodology to take account of updated traffic data and vehicle emission factors. The most recent version of ADMS-Roads (4.1) has been used as has the most recent version of the Emissions Factor Toolkit (EFT (7.0)). In addition, the baseline assessment year and the year for which the model has been verified has been updated to 2016 due to more recent data becoming available.

11.2.3 The modelling has been undertaken using the same approach to vehicle emission factors and background concentrations as in the original assessment; i.e. future traffic data for the year 2021 has been combined with 2018 emission factors and background concentrations, and future traffic data for the year 2031 has been combined with 2025 emission factors and background concentrations, in order to provide a conservative assessment of the effects of the proposed development. As road traffic emissions are predicted to decline with time, selecting earlier emission years for the assessment increases the emissions from the vehicle fleet that are assessed, over and above the emissions in the EFT (whatever the version used). This is considered appropriate for the determination of likely significant effects, which is the requirement for the ES (not worst case effects). Further justification for this is provided in Appendix 11.9, in particular:

- The model verification process takes account of (in addition to other factors) the current under-estimation of emissions from the vehicle fleet that is in the EFT;
- Vehicles corresponding to Euro 6 / VI emission standards are being introduced into the vehicle fleet;
- Emissions testing on these vehicles has shown that NO_x emissions from diesel vehicles corresponding to Euro 6 / VI standards are much lower than previous Euro standards, notwithstanding the fact that they are higher in real-life than the laboratory based emission standards require. Emissions from the vehicle fleet will reduce significantly in the future;
- The introduction of real world emission testing requirements into Euro 6 (from September 2017, tightened in January 2020) will mean that emissions from future Euro 6 diesel cars will be much closer to the laboratory test limits than current Euro 6 vehicle emissions. This will further reduce NO_x emissions from diesel cars compared to current vehicles on the road;
- By 2031, approximately 95% of the diesel cars on the road will be Euro 6 vehicles.

11.2.4 Overall therefore, there is no credible justification for assuming that vehicle emissions in the future will remain at current levels, even if one ignores the introduction of electric/hybrid vehicles.

11.2.5 The effect of emissions from delivery vehicles accessing the site from Clerk Maxwell Road (CMR) can be screened out of detailed modelling. Although there are no residential properties fronting onto CMR, the road provides access to two Cul-de-sacs (Perry Court and The Lawns). CMR has well established vegetation along both sides of the road and is characterised by (uncontrolled) on-road parking on both sides of the road. The residential receptors at the southern end of CMR are therefore well separated from the road. Clerk Maxwell Road itself currently accommodates around 190 car movements daily on the assumption that 95 on street parking spaces are used. Although not all cars park towards the southern end of CMR, often cars in the southern half will drive down to Perry Court to turn before driving north. It is estimated that the Proposed Development will lead to an additional 328 deliveries per week on CMR, of which only 7 would be vehicles greater than 7 tonnes in weight. The additional Annual Average Daily Traffic is only approximately 94 vehicle movements per day, well below the thresholds stipulated in IAQM/EPUK on the assessment of road traffic impacts from development. The total vehicle flows on CMR are also very low, being less than 300 movements per day.

11.2.6 Emissions from the proposed centralised energy centre have been modelled at existing on-site and off-site residential receptors and proposed receptor locations on site, as listed in Appendix 11.1 and shown in Figure 11.1.

11.2.7 The centralized energy centre is the same as for the submitted ES, i.e. 3 CHP units to be installed with up to 3 x 10MW boilers and 1 x 5MW boilers. The total boiler capacity is required to provide heat in the event that the CHP is unavailable and therefore all of the boilers would not normally run, or only for very short periods of time. For the modelling of annual average impacts, we have used the anticipated energy demand as set out in para 11.3.34 of the submitted ES to determine the operating hours of the equipment. The data provided in the submitted ES Appendix 11.4 is for each individual piece of equipment. The annual average modelling has been undertaken for 3 CHP engines and 1 x 10MW boiler to meet the required demand. For the hourly average impacts, it is assumed that the 3 CHP engines, 2 x 10MW boilers and 1 x 5MW boiler would be operating all year round, this is a significant over-estimate of the likely short term energy centre operation.

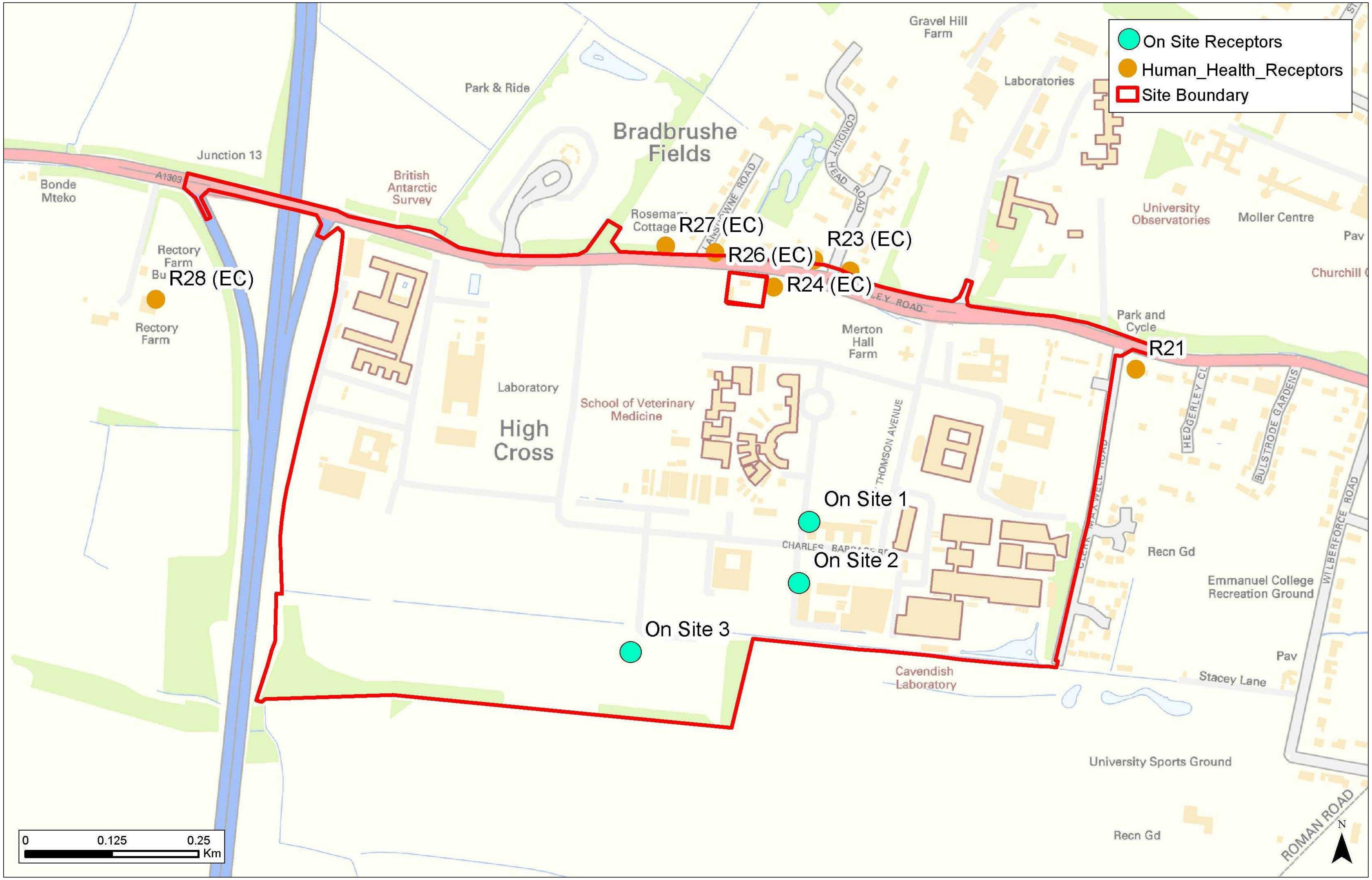

Figure 11.1 Location of air quality receptors

11.2.8 It should be noted in interpreting the contour plots that the annual average NO_2 concentration only applies at the specific receptor locations assessed, i.e. the residential receptor locations on-site and off-site. The predicted hourly average NO_2 concentrations assume that all of the combustion equipment is operating all year round and are therefore significant over-estimates of the actual concentrations that will occur. In addition, the 100^{th} percentile concentration has been predicted which does not take into account the allowable exceedances of the objective.

11.2.9 There is the potential that instead of a centralised energy centre, heat will be provided for each building or clusters of buildings across the site, with part of the energy provision being provided by ground or air source heat pumps. In the case of an individual building approach, CHP would unlikely to be viable. In a distributed energy scenario, each combustion source will be much smaller than a centralised energy centre and the overall quantity of emissions will be lower. Emissions will be dispersed from more points geographically and the maximum ground level concentrations will be lower. The assessment that has been undertaken for the centralised energy centre is therefore considered to be the reasonable worst case scenario.

11.3 Baseline conditions

Monitoring

11.3.1 Since the ES chapter was completed 2015 and 2016 monitoring results have been provided by both Cambridge City Council and South Cambridgeshire District Council. This is shown in the updated Table 11.1, below. No data is available in relation to the hourly mean NO_2 objective in 2015 and 2016 so this has not been updated.

Table 11.1 Measured NO_2 concentrations, (2010 – 2016)

ID	Site Type	Within AQMA	Annual Mean ($\mu g/m^3$)						
			2010	2011	2012	2013	2014	2015	2016
Cambridge City Council Diffusion Tubes									
Madingley Road*	K	N	**53**	**43**	**41**	36	**40.2**	37.9	37.2
Northampton Street	R	Y	**54**	**45**	**41**	38	39.5	38.4	37.4
Magdalene Street	R	Y	**48**	35	31	29	30	28.1	26.5
Victoria Road	R	Y	**49**	37	34	33	33	29.9	28.4
Histon Road 1 NEW[a]*	K	N	-	-	-	30	32	34.7	29.3
Histon Road 1[b]	K	N	**43**	35	35	29	-	-	-
Histon Road 2	R	N	**40**	31	28	28	31.6	30.7	26.9
Huntingdon Road 1*	R	N	36	29	25	25	25	23.9	22.9
Huntingdon Road 2*	R	N	38	29	30	27	23	27.0	22.8
Objective			40						
South Cambridgeshire District Council Automatic Monitors									
Impington (A14)*	R	Y	30	31	31	27	23	22	23
Girton*	R	N	-	-	27	26	25	24	23
Objective			40						
South Cambridgeshire District Council Diffusion Tubes									
1A Weavers Field*	UB	Y	32.4	32.6	29.5	26.8	30.5	27.0	26.2
1 Catchall Farm*	R	Y	36.2	25.6	24.4	26.4	25.4	22.5	24.1
Hackers Fruit Farm*	R	Y	-	28.5	**41.5**	**42.9**	38.0	34.0	37.1
Rhadegund Farm*	R	Y	-	15.7	22.0	26.0	21.7	19.7	20.6
Crafts Way Bar Hill	R	N	30.1	21.4	23.9	23.7	22.9	20.6	24.5
Objective			40						

Exceedances of the objective in bold
[a] Start operation in 2013
[b] Stop operation in 2014
K=Kerbside; R= Roadside; UB= Urban Background
*Used for model verification
Monitoring data for CCC obtained from 2015 Updating and Screening Assessment CCC[13]. Monitoring data for 2015 and 2016 have been provided by CCC
Monitoring data for SCDC obtained from the 2015 Updating and Screening Assessment for SCDC[14]. Monitoring data for 2015 and 2016 has been provided by SCDC.

11.3.2 Monitored concentrations within Cambridge seem to be on a reducing trend between 2014 and 2016. Table 11.2 shows that concentrations are significantly lower in 2016 than in 2010.

Table 11.2 Measured PM_{10} concentrations, (2010 – 2016)

ID	Annual Mean ($\mu g/m^3$)						
	2010	2011	2012	2013	2014	2015	2016
South Cambridgeshire District Council Automatic Monitors							
Impington (A14)	**42**	**54**	**58**	**55**	22	18	17
Girton	-	-	26	30	16	11	17
Objective	40						

Exceedances of the objective in bold
Monitoring data for SCDC obtained from the 2015 Updating and Screening Assessment for SCDC[14]

[13] Cambridge City Council (2015). '*2015 Updating and Screening Assessment for Cambridge City Council*'. Cambridge, UK

[14] South Cambridgeshire District Council (2015). '*2015 Updating and Screening Assessment for South Cambridgeshire District Council*'. South Cambridgeshire, UK

Table 11.3 Measured $PM_{2.5}$ concentrations, (2010 – 2016)

ID	Annual Mean (µg/m³)						
	2010	2011	2012	2013	2014	2015	2016
South Cambridgeshire District Council Automatic Monitors							
Girton	-	-	13	14	12	11	13
Objective	**25**						
Monitoring data for SCDC obtained from the 2015 Updating and Screening Assessment for SCDC[14]							

Background concentrations

11.3.3 The maps of background pollutant concentrations published by Defra have been updated in line with the most recently published emission factors. The updated Table 11.4 is shown below.

Table 11.4 Estimated annual mean background concentrations

Grid Ref	Annual Mean (µg/m³)											
	NO_x			NO_2			PM_{10}			$PM_{2.5}$		
	2016	2018	2025	2016	2018	2025	2016	2018	2025	2016	2018	2025
538_263	20.9	18.4	13.8	14.9	13.3	10.2	18.5	18.2	17.7	12.5	12.2	11.8
539_262	17.8	15.8	12.0	12.8	11.5	9.0	17.6	17.3	16.8	11.9	11.7	11.2
540_259	15.3	13.8	10.7	11.2	10.1	8.0	15.6	15.3	14.9	10.9	10.7	10.2
540_262	21.8	19.1	14.0	15.5	13.7	10.3	19.6	19.3	18.8	13.0	12.7	12.2
541_258	18.5	16.5	12.5	13.3	12.0	9.3	16.9	16.7	16.2	11.6	11.4	10.9
541_259	15.8	14.2	11.0	11.5	10.4	8.2	15.6	15.4	14.9	10.9	10.7	10.2
541_261	24.8	21.6	15.6	17.4	15.4	11.5	18.5	18.2	17.7	12.5	12.2	11.8
542_258	17.7	15.8	12.1	12.8	11.5	9.0	17.1	16.9	16.4	11.7	11.5	11.0
542_259	20.2	17.9	13.4	14.4	12.9	9.9	17.1	16.8	16.3	11.7	11.5	11.0
542_260	19.6	17.5	13.3	14.0	12.6	9.9	16.9	16.7	16.2	11.7	11.4	11.0
542_261	23.0	20.3	15.1	16.2	14.5	11.1	18.0	17.7	17.2	12.3	12.0	11.5
543_259	19.8	17.7	13.7	14.1	12.8	10.1	16.0	15.7	15.2	11.2	11.0	10.5
543_260	18.3	16.5	12.9	13.2	12.0	9.5	15.8	15.6	15.1	11.1	10.9	10.4
544_258	24.3	22.2	17.9	16.8	15.5	12.9	15.5	15.3	14.7	11.1	10.9	10.4
544_259	25.5	23.1	18.3	17.6	16.1	13.1	16.1	15.8	15.3	11.5	11.2	10.7
Objectives	**30[a]**			**40[b]**			**40[b]**			**25[b]**		
[a] Ecosystem; [b] Human Health												

11.3.4 Background concentrations of all pollutants are below or well below the relevant objectives across the study area.

11.4 Impact assessment

Operation

11.4.1 Contour plots of the annual and hourly average NO_2 concentrations from the energy centre at elevations of 1.5m and 22.5m are contained in Figures 11.2 to 11.5. The differences in the contour plots show the effect of buildings on the dispersion of emissions albeit the buildings can only be modelled as blocks at present as detailed design work has not been undertaken.

11.4.2 Table 11.5 below provides a summary of the operation phase effects for the proposed development.

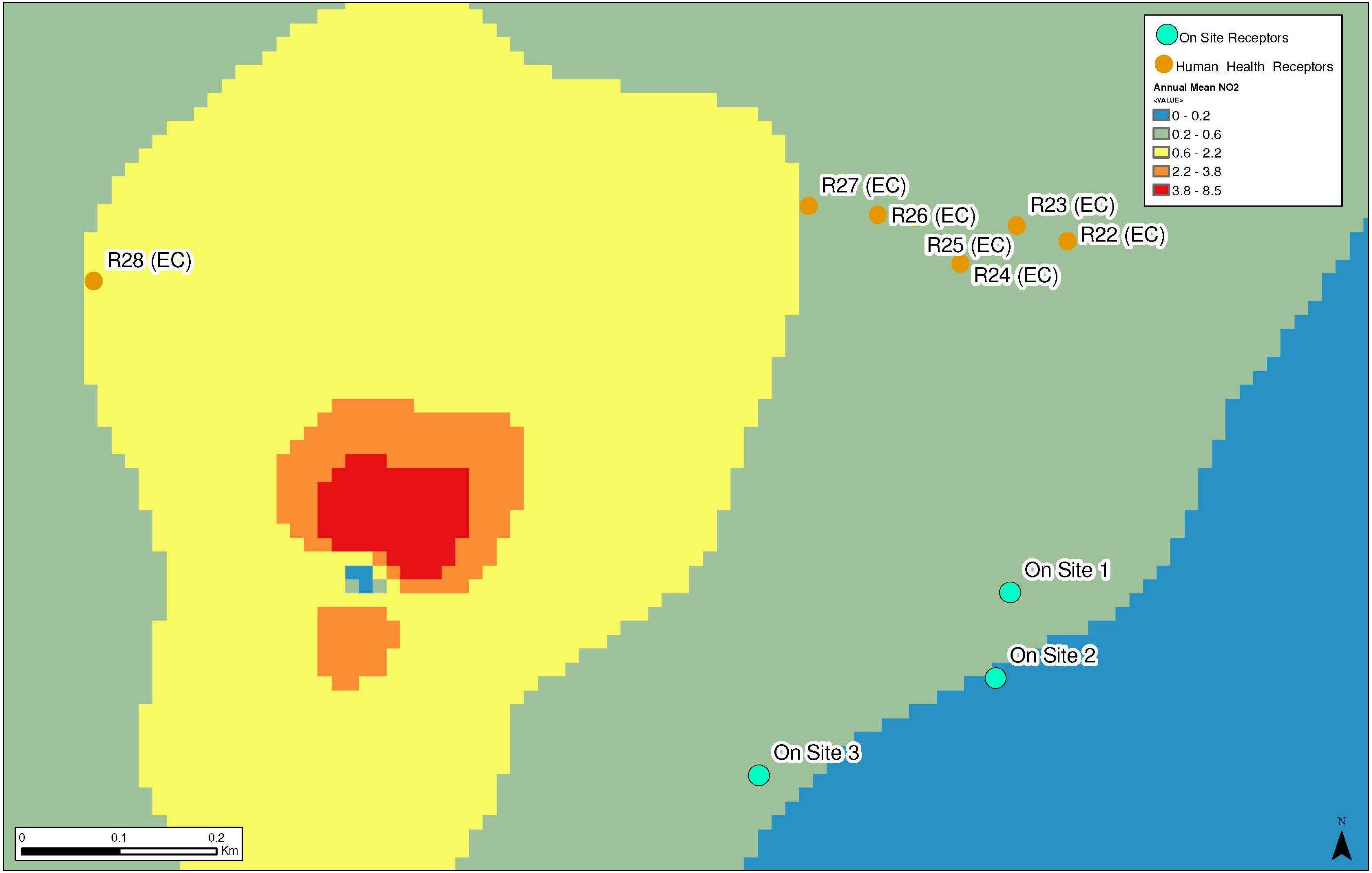

Figure 11.2 Annual mean NO_2 concentrations at 22.5m

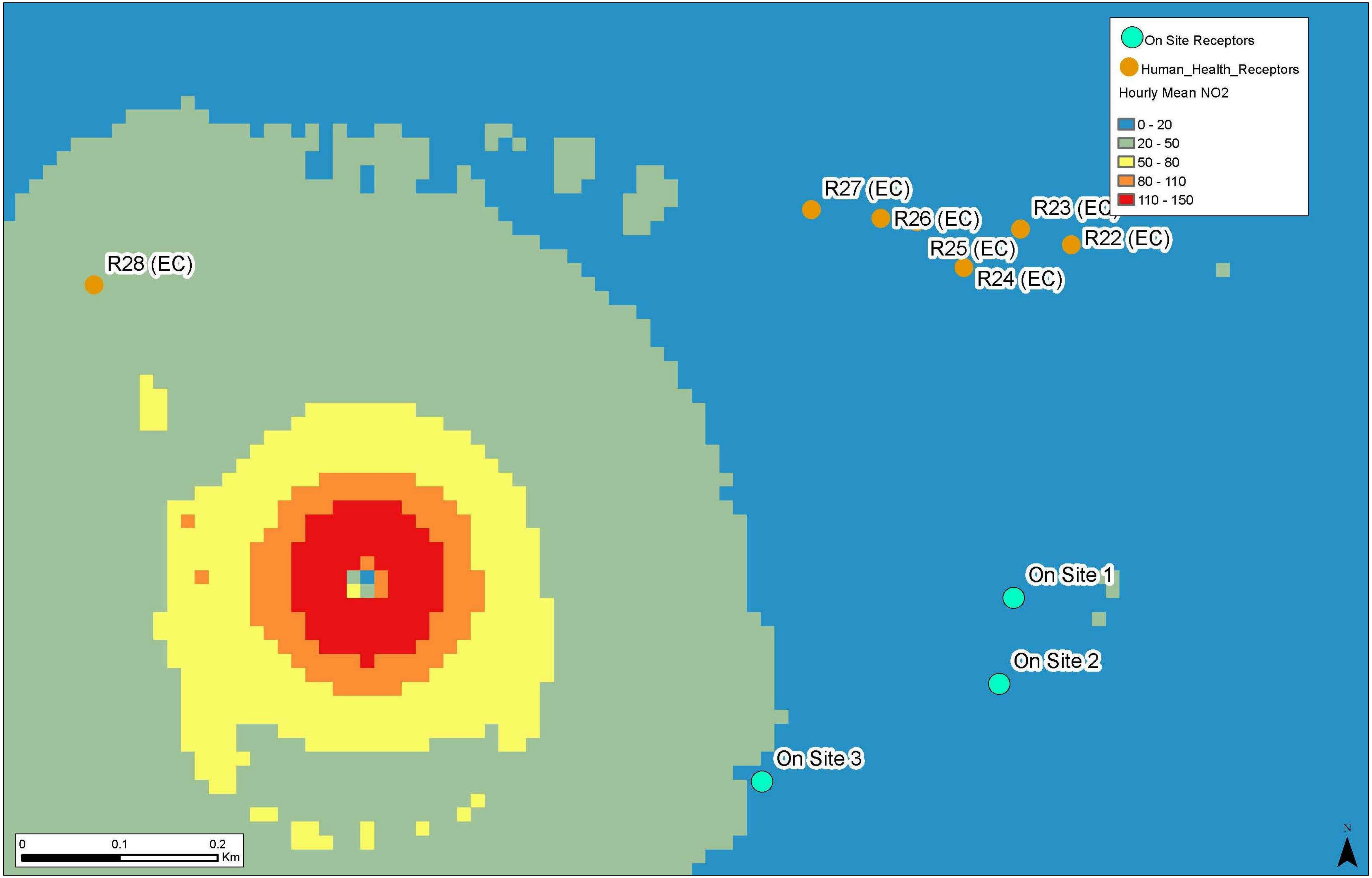

Figure 11.3 Maximum hourly mean NO_2 concentrations at 22.5m

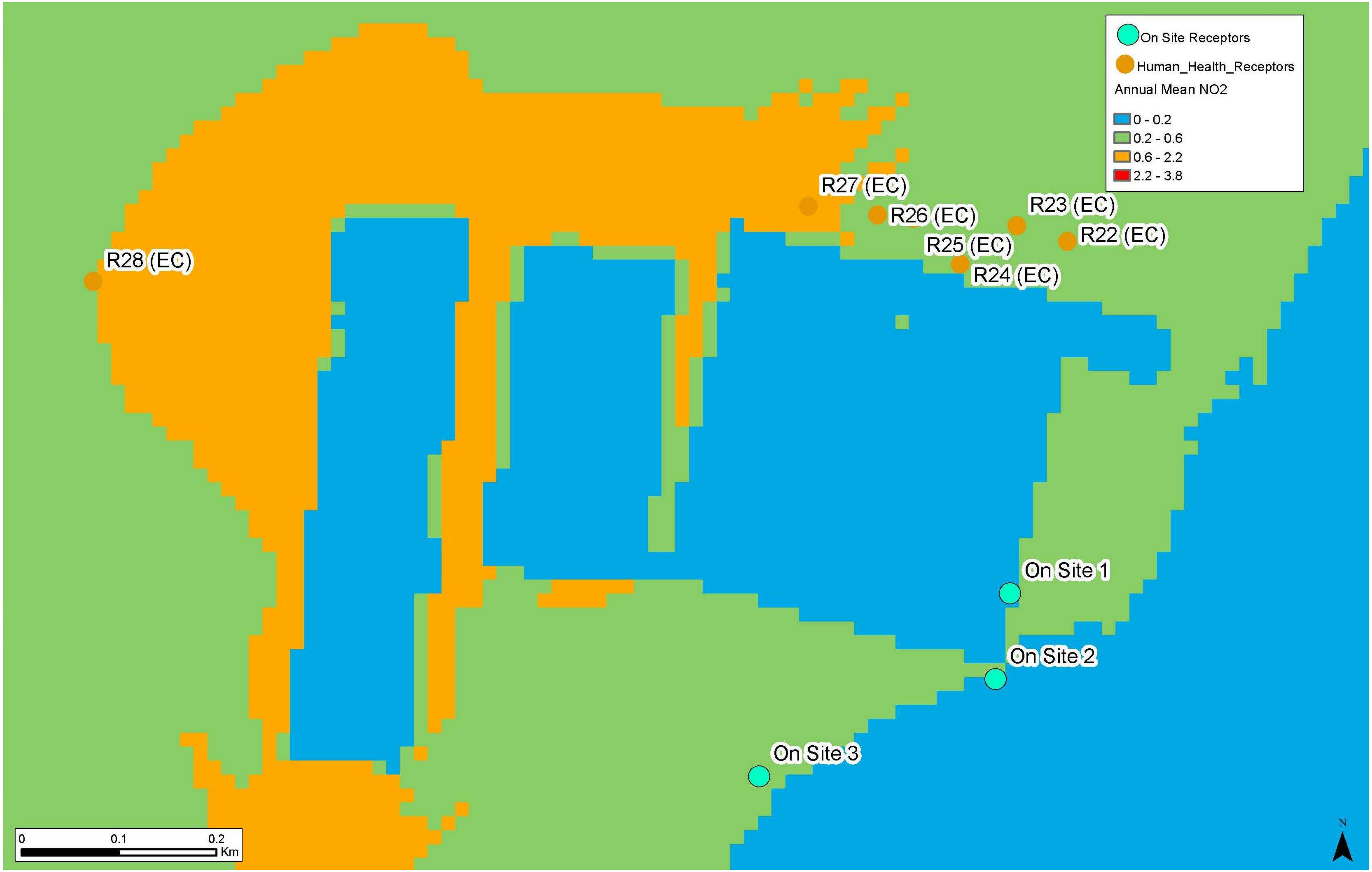

Figure 11.4 Annual mean NO_2 concentrations at 1.5m

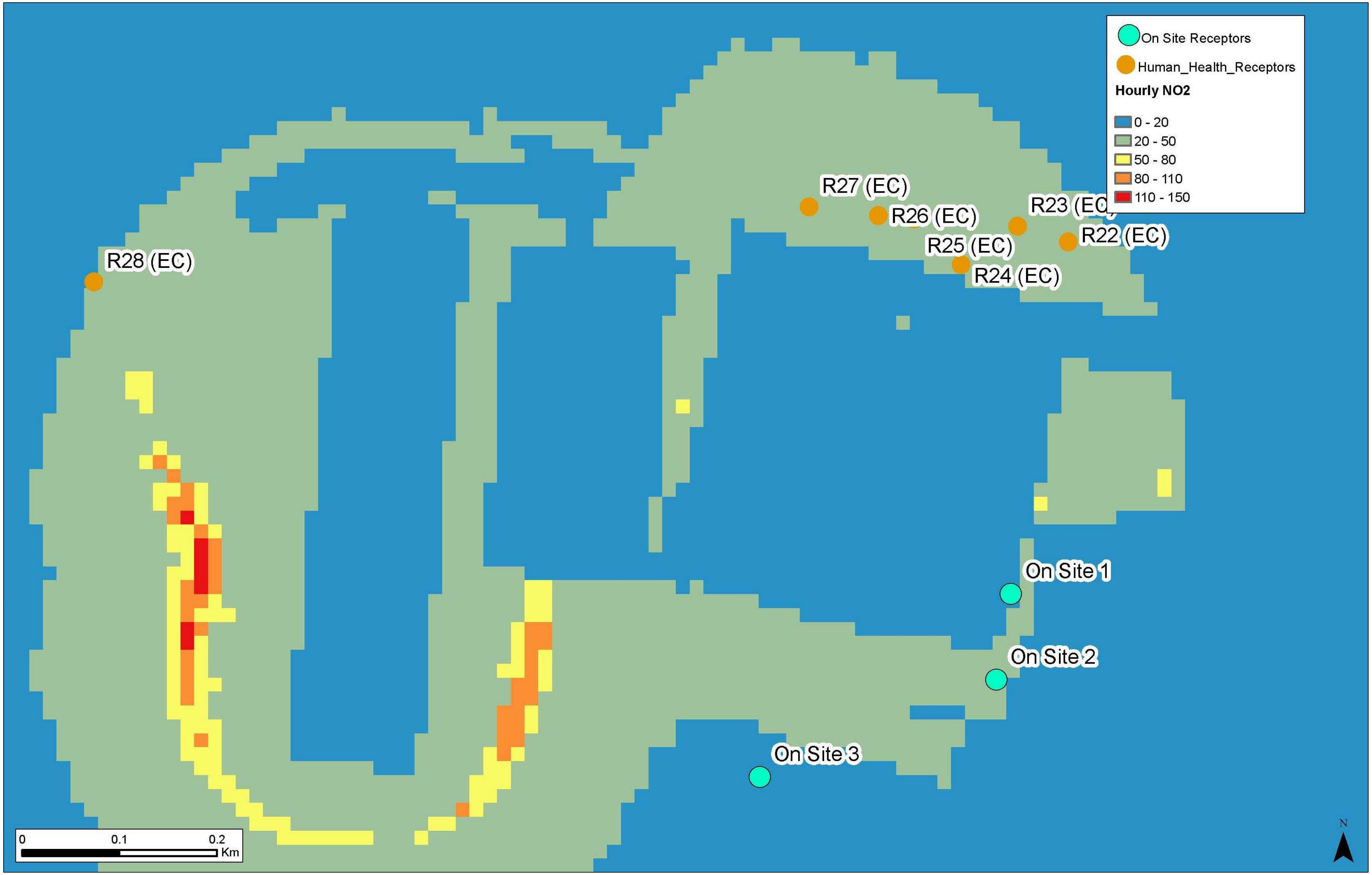

Figure 11.5 Maximum hourly NO_2 concentrations at 1.5m

Table 11.5 Operational phase effects

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Human Health Receptors off-site	High	Increase in road traffic emissions leading to elevated NO_2, PM_{10} and $PM_{2.5}$ concentrations	Not required	Negligible	Predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ at existing receptors in 2021 (Interim Scenario) and 2031 (Full Development), both without and with the Proposed Development in place are presented in Appendix 11.6. **2021 Interim scenario** In 2021, without and with (interim scenario) the development in place NO_2, PM_{10} and $PM_{2.5}$ concentrations are not predicted to exceed the air quality strategy objectives at any of the existing residential receptor locations. The changes in annual mean concentrations are presented in Appendix 11.6. The changes in the annual mean NO_2 concentrations are imperceptible at the majority of the receptor locations with small changes at 5 receptors and medium changes at 13 receptors. The changes in PM_{10} annual mean concentrations are imperceptible at the majority of receptors and small at 2 receptors. The annual mean of 32 µg/m^3 equating to 35 days above 50 µg/m^3 is described as imperceptible at most receptor locations and small at 4 receptor locations. The changes in $PM_{2.5}$ concentrations are described as imperceptible at most receptor locations and small at 5 receptor locations. The impact on pollutant concentrations is classed as negligible at all receptor locations. **2031 With full development scenario** In 2031, without and with the full development in place NO_2, PM_{10} and $PM_{2.5}$ concentrations are not predicted to exceed the air quality strategy objectives at any of the existing residential receptor locations. The changes in annual mean concentrations are presented in Appendix 11.6. The changes in the annual mean NO_2 concentrations are imperceptible at the majority of the receptor locations with small changes at 12 receptors and medium changes at 5 receptors. The changes in PM_{10} annual mean concentrations are imperceptible at the majority of receptors and small at 6 receptors. The annual mean of 32 µg/m^3 equating to 35 days above 50 µg/m^3 is described as imperceptible at most receptor locations and small at 11 receptor locations. The changes in $PM_{2.5}$ concentrations are described as imperceptible at most receptor locations and small at 12 receptor locations. The impact on pollutant concentrations is classed as negligible at all receptor locations.	Negligible **Not significant**
Human Health Receptors off-site and on-site	High	Energy Centre emissions leading to elevated NO_2 concentrations	Not required	Negligible	Predicted concentrations from the energy centre emissions are presented in Appendix 11.8. The significance of the impacts has been judged in accordance with the IAQM/EPUK criteria. There are no predicted exceedances of air quality strategy objectives as a result of emissions from the energy centre. The maximum change in annual mean NO_2 concentrations is described as small. The maximum change in hourly NO_2 concentrations is medium. When considered in conjunction with the baseline concentrations the impact at the worst case receptor is described as negligible. Given that there are no exceedances of air quality strategy objectives the effect of the energy centre emissions is considered to be not significant. Contour plots of the predicted annual average and 1-hour average NO_2 concentrations at elevations of 1.5m and 22.5m are shown in Figures 11.2 to 11.5 to demonstrate the effect of buildings on the dispersion; only the results at the specific receptor sites are relevant for the assessment.	Negligible **Not significant**
Human Health Receptors off-site and on-site	High	Combined Road Traffic and Energy Centre emissions leading to elevated NO2 concentrations	Not required	Negligible	The predicted environmental concentrations in Appendix 11.8 for the energy centre include the contribution from the road traffic in the baseline concentration. The combined impact of road traffic and energy centre emissions is to increase NO_2 concentrations by a maximum of 2.3 and 0.8 µg/m^3 in 2021 and 2031 respectively. This magnitude of change, in combination with the total concentration is described as a negligible impact.	Negligible **Not significant**
Human Health Receptors on-site	High	Emissions from on-site laboratories	Additional abatement may be required.	Negligible	Process abatement will be designed to ensure environmental concentrations do not breach environmental assessment levels specific to the chemical species being released. This will be undertaken during the detailed design stage of the specific laboratory building.	Negligible **Not significant**
Madingley Wood SSSI	High	Road traffic emissions leading to elevated NO_x concentrations and Nitrogen / Acid Deposition	Not required	Negligible	Predicted concentrations and deposition rates without and with the Proposed Development in place in 2021 and 2031 are contained in Appendix 11.7. **2021 Interim scenario** The NO_x critical level is predicted to be exceeded only at the kerb of the road without or with the development in place. The increase in NO_x concentrations is only 1.5% of the critical level at the kerb of the road, and therefore the increase in NO_x concentrations is unlikely to have a significant effect. The nitrogen and acid deposition critical loads are predicted to be exceeded at all of the receptor locations within the habitat in 2021. The increase in nitrogen and acid deposition is less than 1% and therefore not significant. **2031 With full development scenario** The NO_x critical level is not predicted to be exceeded with or without the development in place. The nitrogen and acid deposition critical loads are predicted to be exceeded at all of the receptor locations within the habitat in 2031. The increase in nitrogen and acid deposition is less than 1% and therefore not significant.	Negligible **Not significant**

11.5 Mitigation measures

Construction

11.5.1 Because of the uncertainty around construction works the mitigation measures listed in this section are intended to be a starting point based on the assumptions used for the impact assessment and the subsequently predicted effects. Once details of the construction works activities are known the list will need to be refined based on any change in risk as per the IAQM guidance.

11.5.2 The following mitigation measures are specified in the IAQM guidance for a medium risk site and will be appropriately implemented during construction. The CEMP will specify which works activities will be subject to which specific mitigation measures.

Communication

- Develop and implement a stakeholder communications plan.
- Display the name and contact details of persons accountable on the site boundary.
- Display the head or regional office information on the site boundary.

Management

- Develop and implement a dust management plan.
- Record all dust and air quality complaints, identify causes and take measures to reduce emissions.
- Record exceptional incidents and action taken to resolve the situation.
- Carry out regular site inspections to monitor compliance with the dust management plan and record results.
- Increase site inspection frequency during prolonged dry or windy conditions and when activities with high dust potential are being undertaken.
- Agree dust monitoring locations with the local authority and instigate monitoring 3 months in advance of works commencing in the area.
- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible.
- Erect solid screens or barriers around dusty activities or the site boundary at least as high as any stockpile on site.
- Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Avoid site run off of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove potentially dusty materials from site as soon as possible.
- Cover, seed or fence stockpiles to prevent wind whipping.
- Ensure all vehicles switch off engines when stationary.
- Avoid the use of diesel or petrol powered generators where possible.
- Produce a Construction Logistics Plan to manage the delivery of goods and materials.
- Only use cutting, grinding and sawing equipment with dust suppression equipment.
- Ensure an adequate supply of water on site for dust suppressant.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use water sprays on such equipment where appropriate.
- Ensure equipment is readily available on site to clean up spillages of dry materials.
- No on-site bonfires and burning of waste materials on site.

Earthworks

- Re-vegetate earthworks and exposed areas /soil stockpiles to stabilise surfaces as soon as practicable.
- Only remove the cover in small areas during work and not all at once.

Demolition

- Incorporate soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).
- Ensure water suppression is used during demolition operation.
- Avoid explosive blasting, using appropriate manual and mechanical alternatives.
- Bag and remove any biological debris or damp down such material before demolition.

Construction

- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless required for a particular process.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tanker sand stored silos with suitable emissions control systems.

Trackout

- Use water assisted dust sweepers on the site access and local roads.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving the site are covered to prevent escape of materials.
- Record inspection of on-site haul routes and any subsequent action, repairing as soon as reasonably practicable.
- Install hard surfaced haul routes which are regularly damped down.
- Install a wheel wash with a hard-surfaced road to the site exit where site layout permits.
- The site access gate to be located at least 10m from receptors where possible.

Operation

11.5.3 The effects of the development on local air quality are judged to be not significant. No additional mitigation measures are required to reduce the direct effects of the development. Mitigation measures to reduce vehicular trip generation of the Proposed Development and to reduce vehicle use on the network are described in the Transport Chapter. These mitigation measures will reduce both the transport and air quality effects of the development.

11.5.4 In particular, a fully-funded Framework Travel Plan has been submitted in support of this application. It sets out a wide-ranging series of measures to maximise movement by all non-car modes of travel to the development. It will be reviewed and approved by the Joint Authorities, and delivered in an agreed manner.

11.5.5 The design of the development incorporates appropriate separation distances between sources of pollution and residential receptor locations. There are no residential receptors alongside Madingley Road and the centralized energy centre is located on the west side of the development, well away from the nursery and student accommodation.

11.5.6 Combustion equipment installed as part of the energy centre will be gas fired and therefore there will be no particulate emissions. NO_x emissions will comply with the requirements of the Medium Combustion Plant Directive which is designed to limit emissions from combustion equipment in the size range proposed.

11.5.7 An appropriate number of electric vehicle (EV) charging stations will be provided to cater for both all-day parking slow charging as well as the fast charging points which may be more attractive for visitors, pool vehicles, Car Clubs and taxis. The number of EV charging points will be periodically reviewed so that the provision matches demand.

11.5.8 As part of the Sustainability objectives for the development, the aim is to Incorporate at least two exemplar sustainable University buildings as part of the masterplan. The aim to achieve BREEAM Outstanding or equivalent for each of the exemplar buildings. All other buildings will have to demonstrate why Outstanding is not viable, and will have to achieve BREEAM Excellent as a minimum.

11.6 Summary

11.6.1 Concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been predicted for a number of worst-case locations representing existing properties adjacent to the road network. Predicted concentrations are below the relevant air quality objectives at all of the existing receptor locations in 2021 and 2031 with the proposed development in place. No additional mitigation measures are therefore required to reduce the direct effects of the development.

11.6.2 The increase in NO_x concentrations, nitrogen and acid deposition is unlikely to have a significant effect on the integrity on the Madingley Wood SSSI.

11.6.3 Modelling of the emissions from the energy centre have shown that a flue height of 8m above building parameter plan height is sufficient to disperse emissions without leading to exceedances of air quality objectives.

11.6.4 The operational effects of the proposed development are judged to be negligible and not significant.

12. Noise and vibration

12.1 Introduction

12.1.1 This chapter updates the noise and vibration assessment in the submitted ES to show the changes resulting from the amended Proposed Development. The assessment requires updating due to changes in the predicted traffic flows and due to the energy strategy which now allows for air source heat pumps which can be a source of noise. In addition new noise surveys have been undertaken for specific projects within West Cambridge and the results of these have been used to update the baseline conditions section. Following further discussions with the Cambridge City Council Environmental Health Officer (EHO) further assessments have been undertaken to identify noise impacts from a potential multi-storey car park and access route on to Clerk Maxwell Road. The method of assessment section requires updating to explain how these assessments were undertaken.

12.1.2 The following sections remain unchanged from the submitted ES and have not been replicated within this document.

- Scope of assessment;
- Relevant legislation and policy;
- Mitigation measures.

12.1.3 The following sections require updating to reflect the amended Proposed Development and are presented in this chapter:

- Method of assessment (Operational multi-storey carpark assessment and Operational access route assessment only);
- Baseline conditions;
- Impact assessment – Operational phase only. Construction phase effects remain unchanged;
- Summary

12.2 Method of assessment

Operational multi-storey car park noise impact assessment

12.2.1 A new multi storey car park is proposed towards the north-east boundary of the site providing 540 car parking spaces. The proposed multi-storey car park replaces an existing ground level car ..

12.2.2 The closest residential dwellings lie approximately 50 m to the west of the site at 53 Madingley Road and approximately 150m to the south east of the proposed multi-storey car park at The Lawns of Clerk Maxwell Road. For the purpose of the assessment, sound levels associated with the car park movements and activities have been calculated at these receptors

12.2.3 Local trip generation for the proposed car park has been established based on methodologies detailed in the Transport Chapter.

12.2.4 The AM and PM peak hours have been identified by the associated transport assessment as 08:00 – 09:00 (AM) and 17:00 – 18:00 (PM).

12.2.5 Table 12.1 details the estimated AM peak hour and PM peak hour car movements associated with the proposed development.

Table 12.6 Proposed peak hour car movements

Time Period	Proposed Car Park (540 Spaces)	
	Arrive	Depart
AM Peak Hour 08:00-09:00	262	52
PM Peak Hour 17:00-18:00	48	139

12.2.6 Due to the nature of the proposals, it is anticipated that the key noise impact to existing noise sensitive receptors would be associated with changes in ambient noise levels due to additional vehicle movements and activities (i.e. door slams and switching engines on) during the operation of the proposed new car park. However, the assessment should take into consideration the historical use of the site as a car park, and therefore assess the change in noise levels based on the increases in car park movements due to the increased capacity against the ambient noise levels measured during the peak hour.

12.2.7 The assessment calculates the change in ambient noise levels due to the sound levels generated by the existing and proposed car parks during the AM and PM peak hours at the nearest sensitive residential receptors.

12.2.8 Measurements of car movements associated with the car park have previously been undertaken. Activities measured included:

- Car driving in, manoeuvring and stopping including occupant exiting the car and door slam;
- Occupant getting in car, slamming door and driving away.

12.2.9 The likely noise impact of the car park operations has been assessed based on car arrival (including door slam) and car departure (including door slam). Sound levels used in the assessment for are provided in Table 12.2.

Table 12.7 Typical sound level associated with car park activity

Source	LAE at 3 m (dB)
Car pass by and park	74
Engine starting and car pulling away	77

12.2.10 The assessment of vehicle related noise has been based upon the noise prediction methods detailed in CRTN. This methodology compares changes between the existing ambient sound levels during the peak hours and the potential cumulative ambient sound level at the nearest noise sensitive residential receptor. The calculation methodology also accounts for distance attenuation, angle of view and screening.

12.2.11 Based on national planning requirements and relevant standards the assessment criteria are set out in Table 12.3.

Table 12.8 NOEL, LOAEL and SOAEL for changes in ambient sound levels

Increasing Effect Level	Change in Ambient Sound Level Daytime Free-Field LAeq,16h (dB)	Comments
NOEL	0	No effect; not noticeable.
LOAEL	+3 dB	Noticeable and not intrusive. Unlikely to cause a change in attitude or behaviour. Generally just noticeable.
SOAEL	+10 dB	Noticeable and disruptive. The noise causes a material change in behaviour and/or attitude.

Operational access route noise impact assessment

12.2.12 Servicing access is proposed at certain points along Clerk Maxwell Road. These are identified as I-J (North of Clerk Maxwell Road), K-L (mid-way down Clerk Maxwell Road) and M-N (South of Clerk Maxwell Road) on Parameter Plan: Access and Management.

12.2.13 An indicative assessment has been undertaken in general accordance with BS 4142:2014 to determine the likely noise impact associated with the use of Clerk Maxwell Road for deliveries, servicing and access.

12.2.14 As full details of the specific delivery and servicing activities are not available it has been assumed that activities generating noise along the proposed access road and at the nearest proposed building to the east of the site are likely to include the following:

- Delivery vehicles arriving, parking and departing;
- General loading activities (loading/unloading/movement of trolleys).

12.2.15 The specific sound level of the combined servicing operations has been calculated by considering each activity as an individual sound event and then combining them to obtain the specific sound level within a worst case one-hour period.

12.2.16 The assessment undertaken is based on 1 HGV movement in any worse case hour during a typical day as per the 'Servicing the East of the West Cambridge Site Note – AECOM dated 30/06/17'.

12.2.17 Table 12.4 details the activities associated with the servicing operations, the associated noise level and the number of activities taking place during a worst case 1-hour daytime period. As night-time deliveries are not anticipated; a night time assessment has not been undertaken. Unless otherwise stated, sound levels are based on measurements from our in-house database.

Table 12.9 Noise levels associated with deliveries

Measurement Description	Sound Pressure Level SEL (dB)	Source Level Measurement Distance (metres)	Number of Events During 1 Hour Period (Daytime)
Lorry Arriving	68	1	1
Lorry door slam	83	1	1
Opening lorry shutter	76	1	1
Removing support bars	88	4	14
Moving roll cages inside lorry	93	3	14
Loading roll cages	94	1	14
Wheeling roll cages off into facility	97	1	14
Wheeling empty roll cages from inside the facility to outside	92	3	4
Loading empty roll cages onto lorry	95	1	14
Securing support bars	88	4	3
Closing lorry shutter	76	1	1
Door slam	83	1	1
Lorry Starting	89	1	1
Reversing Alarm	94	1	1
Lorry Driving Away	90	1	1

12.2.18 During the survey to obtain delivery activity source data, the temperature was cool (approx. 10℃), with light winds (< 5m/s), approximately 50% cloud cover and no precipitation. These conditions were considered suitable for obtaining representative source levels.

Noise sensitive receptors

12.2.19 It has been assumed that the nearest noise sensitive receptors to both the access route and the closest proposed building associated with delivery noise will be the existing residential dwellings located identified as noise sensitive receptor K located approximately 20m from the access route and 70m from the closest proposed building associated with delivery noise.

Acoustic feature corrections and reflections

12.2.20 As stated in the Noise and Vibration Impact Assessment prepared by Prepared by Max Fordham. Submitted as part of the planning application for the Civil Engineering Building On the West Cambridge Site, Madingley Road, Cambridge, there is an earth mound between the proposed servicing area and the closest noise sensitive receptors. Along the length of the access road, the height of the earth mound varies. A height of 1.5m above ground level is taken for the purposes of this assessment. Based on line of sight screening the attenuation provided by the barrier is likely to be around 5dB.

12.2.21 Acoustic feature corrections have been applied where considered appropriate. Table 12.5 details the acoustic feature corrections applied.

Table 12.10 Acoustic feature corrections

Source	Acoustic Feature Correction (dB)
Lorry Door Slam	+ 3
Reversing Alarm	+ 6
Earth Mound	- 5

Background sound levels

12.2.22 For the purpose of this assessment background sound levels during the operational periods are detailed in Table 12.6. These noise levels have been derived from the environmental sound survey undertaken for the Noise and Vibration Impact Assessment prepared by Prepared by Max Fordham. Submitted as part of the planning application for the Civil Engineering Building On the West Cambridge Site, Madingley Road, Cambridge.

Table 12.11 Background sound levels

Operational Period	Background Sound Level (dB) LA90,15mins
Daytime (07:00 – 23:00 hours)	47

Uncertainty

12.2.23 Care has been taken to reduce uncertainty as far as reasonably possible. However, it should be recognised that in any environmental sound survey and assessment process uncertainty exists.

12.2.24 The sound level data that forms the basis of the assessment are considered representative of future operations. A degree of uncertainty is therefore inherent in the source level data used. It is considered, however, that the measured operations are an accurate representation of the operation of the access route.

12.3 Baseline conditions

12.3.1 The Site is bounded to the west by the M11 motorway and to the north by the A1303 Madingley Road. These are deemed to be the dominant sources of noise across the Site.

2014 Baseline

Noise

12.3.2 Appendix 12.2, Volume 3 of the submitted ES, contains the detailed results of the noise and vibration surveys undertaken at the Site including time history graphs of the unattended noise survey and vibration surveys.

12.3.3 Table 12.7 presents a summary of the results of the 24-hour unattended noise survey. These results have been used to calibrate the noise model.

Table 12.12 Summary of unattended noise survey results

Measurement location	Daytime $L_{Aeq,16h}$ (dB)	Night-time $L_{Aeq,8h}$ (dB)	Typical night-time L_{AFmax} (dB)	Typical daytime $L_{A90,15min}$ (dB)	Typical night-time $L_{A90,15min}$ (dB)
LT1	75	70	80	72	52
LT2	69	62	82	54	41
LT3	50	44	57	46	43
LT4	59	55	63	58	47
LT5	55	49	58	52	44

12.3.4 Noise levels across the existing site vary considerably due to the large distances between the road traffic sources along the northern and western boundaries and the eastern and southern boundaries as well as the distances between developed areas of the Site. The dominant noise sources across the Site are the M11 motorway and the A1303 Madingley Road with plant noise from some existing buildings on Site contributing to the sound climate in developed areas of the Site.

12.3.5 Temporary traffic lights were located at the junction of Madingley Road and High Cross Road to enable the utilities and highway works for the North West Cambridge project to be undertaken. This caused queues of traffic adjacent to the unattended sound survey location LT2 at busier times of the day. The vibration survey at this location (VS2) was undertaken during free-flowing, evening traffic towards the end of the peak period.

12.3.6 Ambient sound levels measured at Location LT3 were the lowest of the unattended noise survey. This location is well-screened from road traffic noise by existing on-Site buildings and a large bund along the eastern boundary of the Site. Dominant noise sources included vehicles accessing the adjacent car park, pedestrians and cyclists passing the measurement location and plant noise from the Nano-science Centre building.

Vibration

12.3.7 The measured PPV levels at Location VS1 do not exceed 0.14mm/s despite the measurement being undertaken during a peak period of continuous, free-flowing traffic. It was observed that the free flowing traffic contained a high volume of HGVs on the day of measurement.

12.3.8 Some large PPV levels including two incidents where levels exceeded 1 mm/s were measured at VS2 due to the close proximity of passing HGVs and busses to the vibration equipment. Traffic was flowing freely during this measurement.

12.3.9 During the unattended vibration survey at VL1, PPV levels did not exceed 0.8mm/s in any direction. It is noted that Charles Babbage Road (approximately 10m from the measurement location) includes speed bumps at pedestrian crossing points and a 20mph speed limit.

12.3.10 Additional environmental sound surveys have been undertaken by Ramboll UK Limited and Max Fordham to support the 'Cavendish III' and the 'Civil Engineering Building' projects, respectively. With the permission of both consultants the additional data has been used to inform the baseline conditions which form the basis of assessments used within this ES Addendum. These have been reported in this document and have been used to determine appropriate background sound levels at existing dwellings. The additional survey locations are in Figure 12.1

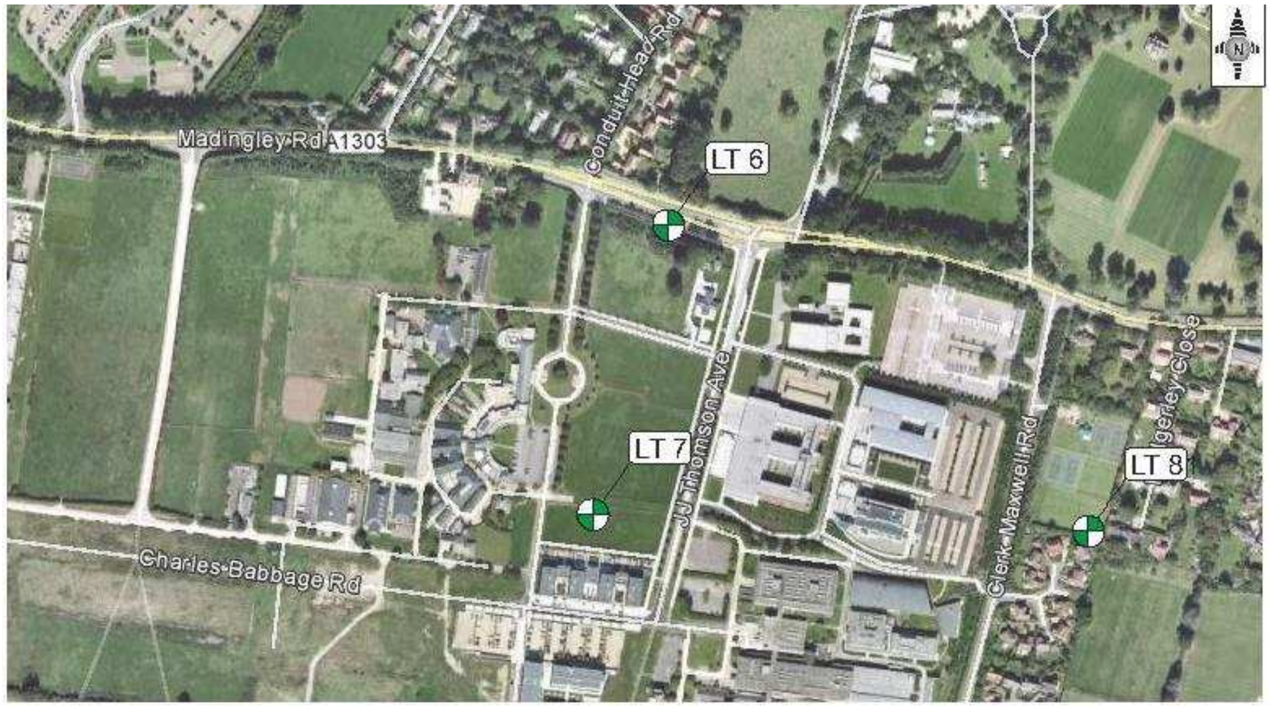

Figure 12.1 Additional noise survey locations

Cavendish III (Ramboll) baseline sound survey results

12.3.11 Ramboll have previously undertaken an environmental sound survey to support the Cavendish III project. The survey methodology and results are detailed in their report referenced 'R01/rev.01'. A summary of the key results is presented in this ES Addendum.

12.3.12 Based on the baseline sound survey the calculated results are summarised in Table 12.8 below. Where appropriate the corresponding noise sensitive receptor has been identified.

12.3.13 Full results are presented in Appendix 12.5

Table 12.13 Cavendish III baseline sound survey results summary

Measurement Position	Time Period	$L_{Aeq, T}$	Typical L_{A90}	Closest Noise Sensitive Receptor
LT6	Daytime (07:00 – 23:00)	57	55	Closest Residential dwellings on Conduit Head Road
	Night time (23:00 – 07:00)	53	47	
LT7	Daytime (07:00 – 23:00)	52	51	N/A
	Night time (23:00 – 07:00)	51	48	

The Civil Engineering Building (Max Fordham) baseline sound survey results

12.3.14 Max Fordham have previously undertaken an environmental sound survey to support the Cavendish III project. The survey methodology and results are detailed in their report referenced Revision Version F. A summary of the key results is presented in this ES Addendum.

12.3.15 The results of the baseline sound survey are summarised in Table 12.9 below. Where appropriate the corresponding noise sensitive receptor has been identified

12.3.16 Full results are presented in Appendix 12.6

Table 12.14 Cavendish III baseline survey results summary

Measurement Position	Time Period	$L_{Aeq, T}$	Typical L_{A90}	Closest Noise Sensitive Receptor
LT8	Day (07:00 – 18:00)	51	47	Closest Residential Dwellings on The Lawns
	Evening (18:00 – 23:00)	49	47	
	Night (23:00 – 07:00)	49	43	

12.4 Impact assessment

Operational phase

Operational road traffic noise

12.4.1 The impact of the Proposed Development on the noise climate in the surrounding areas is based on the change in noise levels at noise sensitive receptors due to a change in the volumes of road traffic generated by the proposed development. Therefore, based on updated traffic flows provided by the transport consultant a revised assessment has been undertaken. These flows are presented in Appendix 12.4. The assessment criteria detailed in the ES has been used to determine the significance of the impacts. Technical details regarding the updated flows are contained in the traffic and transport chapter.

12.4.2 The assessment has been undertaken to consider the likely impact during daytime (07:00 – 23:00) periods during the week which is considered to be the worst case. A night-time assessment has not been undertaken as the resultant traffic flows are equal to or less than 3 % of the overall AAWT traffic flows. Similarly, an assessment based on the weekend periods has not been undertaken as the resultant weekend 24-hour traffic flows are equal to or less than 30% of the overall AAWT 24 hour traffic flows.

12.4.3 Figure 12.2 presents the change in noise levels due to road traffic in the long term. A comparison has been made between the 2021 Do Minimum - 'Without Development' and 2031 Do Something – 'With Development' scenarios. Table 12.10 presents a summary of the predicted change in road traffic noise levels in the long term based on the supplied traffic flow predictions.

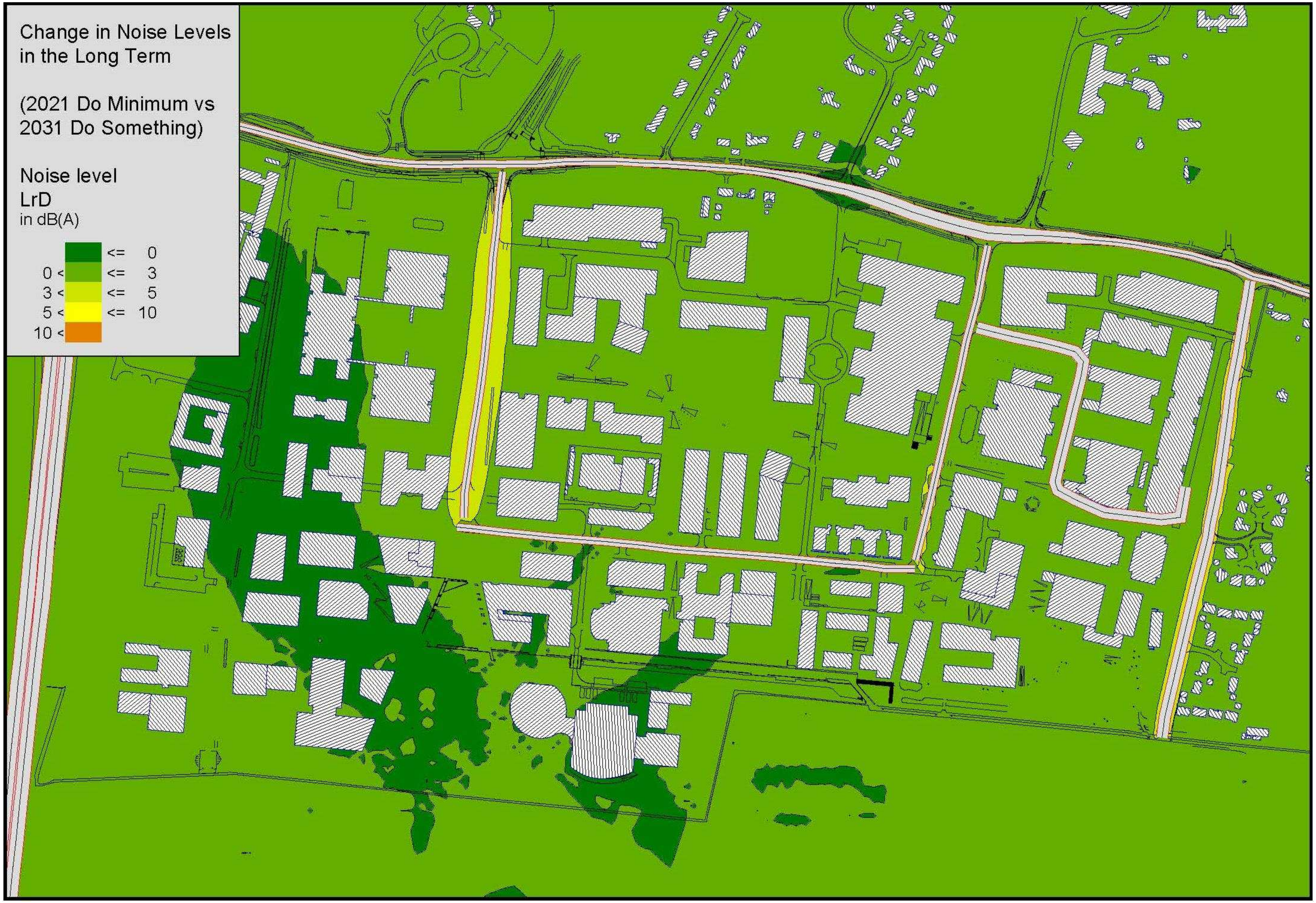

Figure 12.2 Change in noise levels due to road traffic and operational multi-storey car park assessment

Table 12.15 Summary of predicted change in noise levels due to the increase in long term road traffic noise

Noise sensitive receptor	Reference letter (see Figure 12.1 in submitted ES)	Long term changes in ambient noise levels due to the increase in traffic flows. (dB)	Adverse Effect Level
1 + 2 Rosemary Cottages	A	< 3	< LOAEL
1 Lansdowne Rd	B	< 3	< LOAEL
2 Lansdowne Rd	C	< 3	< LOAEL
34 + 36 Madingley Rd	D	< 3	< LOAEL
Whitehouse Apartments	E	< 3	< LOAEL
14 Conduit Head Rd	F	< 3	< LOAEL
53 Madingley Rd	G	< 3	< LOAEL
51 Madingley Rd	H	< 3	< LOAEL
Blenheim Court	I	< 3	< LOAEL
Churchill Court	J	< 3	< LOAEL
1+2 The Lawns	K	< 3	< LOAEL
1+2 Perry Court	L	< 3	< LOAEL

Operational multi storey car park assessment

12.4.4 Table 12.11 details the calculated sound level at the nearest noise sensitive residential receptors and the subsequent change in ambient sound level.

Table 12.16 Car park noise impact assessment summary

Noise Sensitive Receptor (see Figure 12.2 submitted ES)	Time period	Measured Existing Sound Level (dB $L_{Aeq,1hour}$)	Calculated Proposed Sound Level (Car Park Only) (dB $L_{Aeq,\,1hour}$)	Cumulative Ambient Sound Level at Receptor (dB $L_{Aeq,\,1hour}$)	Subsequent Change in Car Park Sound Level (dB)	Subjective Effect
K	AM Peak Hour 08:00-09:00	51	51	54	3	LOAEL
	PM Peak Hour 17:00-18:00		50	53	3	LOAEL
G	AM Peak Hour 08:00-09:00	57	55	59	2	< LOAEL
	PM Peak Hour 17:00-18:00		54	59	2	< LOAEL

12.4.5 Calculations indicate that the change in ambient sound level following the introduction of the new car park are unlikely to exceed proposed LOAEL during AM and PM peak hours and should therefore be considered acceptable.

12.4.6 Example calculations are presented in Appendix 12.8.

Operational access route noise impact assessment

12.4.7 The rating level associated with servicing activities has been calculated and the assessment summarised in Table 12.12.

Table 12.17 Indicative Access Route Assessment

Time Period	HGV Delivery Assessment	
	Daytime (07:00 – 23:00 hours) Typical Week Day	Daytime (07:00 – 23:00 hours) Weekend Day
Combined Rating Level (dB LAr,Tr) at Existing Noise Sensitive Receptor	42	42
Background Sound Level (dB LA90, 15 min)	47	42
Excess of Rating over Background Sound Level (dB)	-5	0
Assessment of Impact	indication of the specific sound source having a low impact, depending on the context	indication of the specific sound source having a low impact, depending on the context

12.4.8 The initial numerical assessment should be considered in relation to the context of the site and any mitigating factors.

12.4.9 The initial numerical assessment of sound levels associated with the proposed access route and associated delivery noise at the nearest proposed noise sensitive receptor indicates that the operation of Clerk Maxwell Road for servicing and access is likely to result in a less than adverse impact during the daytime.

12.4.10 Example Calculations are presented in Appendix 12.9.

Operational plant noise emissions

12.4.11 At this stage, it is unknown what type of plant services will be required to serve the range of potential uses.

12.4.12 Based on the plant noise emissions criteria and the background noise levels measured during the additional environmental sound surveys, cumulative plant noise emissions at the nearest noise sensitive receptor should not exceed the values in Table 12.13.

Table 12.18 Cumulative plant noise emission levels

Time period	Façade of Noise sensitive Receptor	Cumulative Plant Noise Emission Criteria ($L_{Aeq,T}$)
Daytime (07:00 – 19:00) Evening (19:00 – 23:00)	LH	55
	On site Receptors	50
	K	47
	H	51
	On site Receptors	49
Night-time Night-time (23:00 – 07:00) **Time period**	K	47
	H	47
	On site Receptors	48
	K	43

12.4.13 Operational phase impacts are assessed in Table 12.14.

Table 12.19 Operational phase effects

Baseline		Impact assessment				
Receptor	**Value / sensitivity**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Off-site noise sensitive receptors (residential and academic/commercial buildings)	Medium-High	Increase in road traffic noise levels due to increased road traffic volumes	No additional mitigation measures suggested.	Negligible	Based on the results of the assessment, the predicted increase in road traffic noise for the closest noise sensitive receptors does not exceed the proposed LOAEL in the long term.	Negligible **Not significant**
On-site, external amenity areas	Low	Road traffic noise	• Positioning of proposed buildings to screen noise source	Low		Minor Adverse **Not significant**
All off-site and on-site noise sensitive receptors	Low-High	Noise from plant/Energy Centre	• Meet noise limits agreed with CCC • Enclose plant within the building envelope; • Selecting suitably attenuated 'low noise' plant; • Positioning air intake/discharge louvres away from noise sensitive receptors; • Orientating air intake/discharge louvres away from noise sensitive receptors; • Attenuation of air intake/discharge louvres with duct mounted attenuators; and • Sound insulating plant housings/enclosures.	Negligible (Provided plant noise emission limits are meet)	Noise from plant has the potential to be a direct, permanent adverse effect associated with the development. Depending on the type and use of the plant, the effect may be episodic, particularly if the plant is used intermittently. Mitigation measures would minimise any effects including meeting noise limits agreed with CCC.	Negligible **Not significant**
Off-site noise sensitive receptors (residential and academic / commercial buildings)	Medium-High	Increase in road traffic noise levels due to increased road traffic volumes	• No additional mitigation measures suggested.	Negligible	Based on the results of the assessment, the predicted increase in road traffic noise for the closest noise sensitive receptors does not exceed the proposed LOAEL in the long term.	Negligible **Not significant**

12.5 Mitigation Measures

Construction phase

Construction noise

12.5.1 The following mitigation measures will be implemented during construction.

- Best practice construction methods to control noise and vibration from demolition and construction activities would be specified in a site-specific Construction Environmental Management Plan (CEMP). The CEMP would be agreed in consultation with Cambridge City Council at the reserved matters stage and could include the following routine noise and vibration management controls:
  - Breaking out of concrete structures would be undertaken, where possible, using low noise effect methods including bursting and splitting rather than percussive breaking;
  - Detailed programming of works to make maximum use of existing barriers to noise;
  - Retention of the outer walls of structures for as long as possible before demolition is necessary;
  - Careful selection of demolition/construction methods and plant to be used;
  - Switching off of plant and vehicle engines when not in use;
  - Restriction of drop heights onto lorries;
  - Regular maintenance and servicing of vehicles, equipment and plant;
  - Appropriate handling and storage of materials;
  - Appropriate operational hours (to be agreed with the local authority);
  - Enforcement of restricted working hours for excessively noisy activities;
  - Implementation of an appropriate traffic management strategy; and

  - Use of temporary acoustic barriers where appropriate and other noise containment measures such as screens, sheeting and acoustic hoardings at the construction site boundary to minimise noise breakout and reduce noise levels at the potentially affected receptors.
- Agreement with Cambridge City Council and neighbours on suitable approach to noisy activities if a temporary source of noise cannot reasonably be prevented and the works being undertaken are crucial to progressing the particular project phase.
- Keep neighbours and stakeholders (including the existing commercial and university occupants as well as nearby residential inhabitants) informed about construction activities. Measures for community liaison would be dealt with by a dedicated Community Liaison Officer to co-ordinate the dissemination of information (for example, by means of a regular newsletter) and to program those operations at time that would minimise the potential for disturbance.

Construction vibration

12.5.2 Further controls may be required to ensure vibration sensitive equipment or experiments in the existing buildings are protected from damage or malfunction. Appendix B.5 of BS 5228 Part 2 reviews the assessment of vulnerability of contents of buildings such as scientific laboratories or microelectronics manufacturing.

12.5.3 Precise details and locations of vibration sensitive equipment or long-term vibration sensitive experiments are unknown at this stage. Additionally, some buildings which are likely to house vibration sensitive uses, such as the Cavendish Laboratory, are scheduled for demolition as part of the masterplan. Once a demolition and construction programme is available, suitable vibration limits and the requirement for vibration monitoring will be determined. This could include the following measures:

- Specification in the CEMP for further measures;
- Further investigation into existing vibration levels;
- Setting vibration limits; and
- Continuous vibration monitoring

Operational phase

Operational road traffic noise

12.5.4 An additional assessment of operational road noise has been undertaken to reflect the change in traffic flows due to additional works on the transport chapter of the ES. The additional assessment indicates that the changes in noise levels at all noise sensitive receptors fall below the proposed LOAEL.

Operational plant noise emissions

12.5.5 Plant will be selected, located and attenuated so that planning conditions attached to the development by Cambridge City Council are satisfied. This is likely to require meeting noise limits provided in Table 3.12 at nearby receptors through a combination of the following environmental noise control techniques which could be implemented:

- Enclosing noisy plant within the building envelope;
- Selecting suitably quiet ‘low noise’ plant;
- Positioning air intake/discharge louvres away from noise sensitive receptors;
- Orientating air intake/discharge louvres away from noise sensitive receptors;
- Attenuation of air intake/discharge louvres with duct mounted attenuators; and
- Sound insulating plant housings/enclosures.

Energy strategy

12.5.6 The above mitigation measures should also be considered in the design of the Energy strategy as this is likely to be a major plant noise source.

12.5.7 As the Energy Centre could be housed within a building, particular attention to the orientation and attenuation of air intake / discharge louvres and flues will be considered at detailed design.

12.6 Summary

12.6.1 The ES Addendum has presented an additional assessment of potential noise impacts during the operational phase.

12.6.2 An additional assessment of operational road noise has been undertaken to reflect the change in traffic flows due to additional works on the transport chapter of the ES. The additional assessment indicates that the changes in noise levels at all noise sensitive receptors fall below the proposed LOAEL.

12.6.3 An assessment has been undertaken to consider the potential impact of the proposed multi-storey car park towards the north east of the development site. The initial assessment indicates that the change in car park sound levels are not likely to exceed the proposed LOAEL and should therefore be considered acceptable.

12.6.4 An assessment of the proposed servicing and access route has been undertaken to consider the potential noise impact associated with HGV movements on Clerk Maxwell road. The initial assessment of sound levels at the nearest proposed noise sensitive receptor indicates that the operation of the proposed access route is likely to result in a less than adverse impact and therefore not exceed the proposed LOAEL during the daytime. No deliveries are anticipated during the night time periods; therefore, an assessment of night time impact has not been undertaken.

13. Water environment

13.1.1 This chapter updates the water environment in the submitted ES to show the changes resulting from the updated drainage strategy. The only changes relate to the mitigation measures and these have not resulted in any change to the impact assessment itself. The following sections remain unchanged from the submitted ES and have not been replicated within this document.

- Scope of assessment;
- Relevant legislation and policy;
- Method of assessment;
- Baseline conditions;
- Impact assessment;
- Summary.

13.1.2 The following sections require updating to reflect the amended Proposed Development and are presented in this chapter:

- Mitigation measures (operational phase only).

8.5 Mitigation measures

Operational phase

13.1.3 Operational effects will typically be avoided through the incorporation of measures within the design process. the following controls are integral to the design:

- Discharge from the Site will be designed to be the equivalent of 1 in 1 year Greenfield run off rate. The 1 in 1 year Green field run off rate has also been reduced by 10% from the rates originally agreed with the Environment Agency for the 1999 consented master plan.. This will be achieved through Site-wide measures (e.g. the operation of the drainage system on the Site's southern boundary) and plot specific controls (e.g. permeable paving and temporary storage). The appropriate sustainable urban drainage (SuDs) standards will be applied where appropriate;
- An allowance of 40% has been used to take account of increased rainfall intensities resulting from predicted climate change. Flood risk will be mitigated up to and including the 1 in 100 year return period, including climate change. An additional 40% in storage volume to accommodate post development flows will be provided. This requires significant attenuation to be provided across the site to mitigate flood risk. Mitigation measures include modifications to the existing Western Lake, Canal and South Eastern pond, to provide increased storage capacity for the Western and Central catchments. Development located within the Eastern catchment will provide attenuation by the provision of on plot storage. Discharges will be limited to the 1 in 1 year Greenfield run off rate;
- Where spatial constraints allow, roadside bio retention areas will be constructed to facilitate the treatment and conveyance of highway run off;
- The Canal and South Eastern pond will be planted with suitable aquatic planting such as reed beds which will facilitate removal of potential contaminants;
- The drainage system will be designed to include the treatment of runoff to manage the removal of silt and other pollutants. Proprietary pollution mitigation systems will be installed at strategic locations on the proposed network to supplement SuDs treatment measures. Sediment monitoring is proposed to characterise current operational effects and inform the detailed design of drainage systems for the plots as they are developed;
- The majority of drainage from the Site will be routed in a southerly direction, reducing potential effects on the Washpit Brook and the North West Cambridge development. The design of the revised system will, as a minimum, reflect its current ecological and amenity value:
- Periodic CCTV inspections of on Site sewers and cyclic jetting will be undertaken as part of the Site wide maintenance;
- Cyclic maintenance of on Site surface water drainage assets will be undertaken in accordance with LLFA guidance. Attenuation will be provided a on phased basis as plots are developed; and
- Anglian Water is assessing the capacity available through a foul water impact study. If required tanked sewers would be provided to mitigate increased demand.

13.1.4 Reflecting the nature of the operational use of the Site, it is recommended that measures are implemented to ensure that the operation of facilities aligns to appropriate legislative requirements for the storage, use and disposal of chemicals which may be harmful to the aquatic environment. As a minimum, a review will be conducted to ensure that all activities using and disposing of chemicals, plus all chemical and material stores comply with current consenting requirements and include adequate pollution prevention measures. The findings of this review will be presented spatially alongside the existing foul and surface water drainage systems to identify potential vulnerabilities in the system. This could also be conducted alongside awareness raising for staff using the Site to ensure that they are aware of procedures and the potential consequences of not complying with prescribed procedures (e.g. ecological effects, prosecution, reputational damage).

14. Ground conditions

14.1 Introduction

14.1.1 This chapter updates the ground conditions assessment in the submitted ES to show the changes resulting from the amended Proposed Development. The assessment requires amending due to the amended energy strategy which now includes an option for ground source heat pumps. The following sections remain unchanged from the submitted ES and have not been replicated within this document.

- Scope of assessment;
- Relevant legislation and policy;
- Method of assessment;
- Baseline conditions.

14.1.2 The following sections require updating to reflect the amended Proposed Development and are presented in this chapter:

- Impact assessment;
- Mitigation measures;
- Summary.

14.2 Impact assessment

Construction phase

14.2.1 Construction phase impacts are assessed in Table 14.1.

Table 14.20 Construction phase effects

Baseline		Impact assessment				
Receptor / hazard	**Assessed risk**	**Impact**	**Mitigation measure**	**Assessed risk**	**Residual effect**	**Significance of effect**
Site workers	Low	There is a possibility that other sources of contamination may be encountered during the construction works that have not been identified by the Phase 1 study or future ground investigation. Site workers encountering potential localised areas of contamination on Site.	• Appropriate protective clothing and equipment will be worn by site workers; and good standards of hygiene adopted to prevent prolonged skin contact, inhalation and ingestion of soils during construction • In addition, the methods of working will be selected to limit the potential for air-borne dust to arise associated with the excavation and disturbance of the soils present on the Site. • Ensure workers at risk of encountering potentially hazardous materials have had appropriate training. • As part of the CEMP, a watching brief for the visual and olfactory assessment of the soil quality will be maintained with sampling and testing for verification and assessment purposes where necessary, together with treatment as required	Low	The risk to Site workers during construction will be minimal providing mitigation is implemented.	Negligible / minor adverse **Not significant**

Baseline		Impact assessment				
Receptor / hazard	**Assessed risk**	**Impact**	**Mitigation measure**	**Assessed risk**	**Residual effect**	**Significance of effect**
Site users / neighbours	Low	Site users / neighbours potential exposure to contaminated dust mobilised during construction activity	Methods of working will be selected to limit the potential for air-borne dust to arise associated with the excavation and disturbance of the soils present on the Site. These are detailed in Chapter 11 and will be specified within the Soils Management Strategy which will form part of the CEMP.	Low	The risk to Site users / neighbours during construction will be minimal providing mitigation is implemented.	Negligible / minor adverse **Not significant**
Ground water	Very Low	Potential introduction of new contaminant sources due to the release of contaminants from construction activity e.g. spill / leaks from defective plant and un-bunded fuel storage areas, silt-laden runoff from poorly managed stockpiles and poor site surface water management. Potential migration of new and existing contaminants in groundwater due to construction activity e.g. creation of contaminant pathways due to the introduction of service trenches, areas of loosely compacted fill, boreholes for ground source heat pumps, piling etc.	Implementation of standard environmental protection measures during construction as set out in CIRIA C532 and the Environment Agency's former Pollution Prevention Guidance (PPG) series as further detailed in Chapter 13 water environment. Preparation of appropriate application documents and associated assessments and adherence to Environment Agency consent and licence requirements for any proposed engineering works (e.g. for possible open loop ground source heat pumps) penetrating the base of the Gault Clay and abstracting groundwater from the underlying strata and/or discharging into the same strata.	Low	The risk to ground water during construction will be minimal providing mitigation is implemented. Groundwater on the Site is not in continuity with off-site Principal Aquifers. The Site is situated on a significant thickness of clay soil with very low permeability. Therefore, the risk to the off-site Principal Aquifers is considered to be negligible during construction.	Minor adverse **Not significant**
Ecology and wildlife	Very Low	Potential migration of new and existing contaminants in surface water and groundwater due to construction activity e.g. creation of contaminant pathways due to the introduction of service trenches, areas of loosely compacted fill, piling etc.	Implementation of standard environmental protection measures during construction as set out in CIRIA C532 and the Environment Agency's former Pollution Prevention Guidance (PPG) series as further detailed in Chapter 13 water environment	Low	The risk to ecology and wildlife during construction will be minimal providing mitigation is implemented.	Minor adverse Not significant

Operational phase

14.2.2 Operational phase impacts are assessed in Table 14.2.

Table 14.21 Operational phase effects

Baseline		Impact assessment				
Receptor / hazard	**Assessed risk**	**Impact**	**Mitigation measure**	**Assessed risk**	**Residual effect**	**Significance of effect**
Site occupants	Low	Exposure of occupants to potential localised areas of contamination present on Site.	Further to the results of future ground investigation, appropriate gas protection measures may be required in new buildings.	Very Low	Where future ground investigation and contamination risk assessment indicates that localised remedial action may be required, this will be undertaken as part of the construction works such that the residual risks will be not significant. This will be a benefit of the Proposed Development which will reduce the risk to Site occupants.	Minor beneficial **Not significant**
Site users / neighbours / workers	Low	Exposure of Site users / neighbours to potential localised areas of contamination present on Site. Potential for hazardous ground gases to be present emanating from Gault Clay.	• Further to the results of future ground investigation, appropriate gas protection measures may be required in new buildings. • In accordance with current health and safety legislation, the maintenance contractor will be required to adopt measures to mitigate the risk to Site workers.	Very Low	Where future ground investigation and contamination risk assessment indicates that localised remedial action may be required, this will be undertaken as part of the construction works such that the residual risks will be not significant. This will be a benefit of the Proposed Development which will reduce the risk to Site users and neighbours.	Minor beneficial **Not significant**

Baseline		Impact assessment				
Receptor / hazard	**Assessed risk**	**Impact**	**Mitigation measure**	**Assessed risk**	**Residual effect**	**Significance of effect**
Ground water	Very Low	Uncontrolled / accidental discharge of potential pollutants used on Site during operation.	• The placement of buildings / hardcover, as well as replacement of the existing surface water drainage system will mitigate against the risk of potential mobilisation / migration of any residual potential contaminants. • The removal and / or remediation of any contamination sources discovered, together with any localised remedial action necessary, will reduce the risk of migration of contaminants impacting ground waters.	Very Low	The risk to ground water during operation will be minimal providing mitigation is implemented.	Negligible **Not significant**
Ecology and wildlife	Very Low	Uncontrolled / accidental discharge of potential pollutants used on Site during operation.	Incorporation of measures to mitigate against potentially contaminated run-off e.g. bunding in areas of fuel and chemical storage, adoption of oil / silt interceptors in drainage design, control valves on outlet structures to ponds and drainage features etc.	Very Low	The risk to ecology and wildlife during operation will be minimal providing mitigation is implemented.	Negligible **Not significant**

14.3 Mitigation measures

14.3.1 The confirmation of ground conditions at the Site by intrusive investigation will enable a further assessment of the potential ground hazards and the presence / extent of potential sources of contamination identified within the Phase 1 assessment. Mitigation measures proposed are generally considered as a worst case scenario, based on the currently available information.

Construction phase

14.3.2 Site workers – The risk to Site workers during the construction works relates to the risk of skin contact, inhalation and ingestion of contaminated material on Site. In accordance with current health and safety legislation, the contractor will be required to adopt the following measures to mitigate the risk to Site workers, and these will be incorporated in the CEMP:

- Appropriate protective clothing and equipment will be worn by site workers; and good standards of hygiene adopted to prevent prolonged skin contact, inhalation and ingestion of soils during construction;
- In addition, the methods of working will be selected to limit the potential for air-borne dust to arise associated with the excavation and disturbance of the soils present on the Site;
- Ensure workers at risk of encountering potentially hazardous materials have had appropriate training
- As part of the CEMP, a watching brief for the visual and olfactory assessment of the soil quality will be maintained with sampling and testing for verification and assessment purposes where necessary, together with treatment as required.

14.3.3 Site users / neighbours – Methods of working will be selected to limit the potential for air-borne dust to arise associated with the excavation and disturbance of the soils present on the Site. These are detailed in Chapter 11 and will be specified within the Soils Management Strategy which will form part of the CEMP.

14.3.4 Ground water – Implementation of standard environmental protection measures during construction set out in CIRIA C532 and the Environment Agency's former Pollution Prevention Guidance (PPG) series as further detailed in Chapter 13 water environment (refer to the submitted ES). Preparation of appropriate application documents and associated assessments and adherence to Environment Agency consent and licence requirements for any proposed engineering works (e.g. for possible open loop ground source heat pumps) penetrating the base of the Gault Clay and abstracting groundwater from the underlying strata and/or discharging into the same strata.

Operational phase

14.3.5 The mitigation measures outlined below will be implemented during the operational phase of the Proposed Development.

- Site occupants / users / neighbours – Further to the results of future ground investigation, appropriate gas protection measures may be required in new buildings.
- Site workers – The risk to Site workers during any subsequent maintenance works relates to the risk of skin contact, inhalation and ingestion of any residual as yet undetermined contaminated material on Site. In accordance with current health and safety legislation, the maintenance contractor will be required to adopt measures to mitigate the risk to Site workers.
- Ground water – The placement of buildings / hardcover, as well as replacement of the existing surface water drainage system will mitigate against the risk of potential mobilisation / migration of any residual potential contaminants. The removal and / or remediation of any contamination sources discovered, together with any localised remedial action necessary, will reduce the risk of migration of contaminants impacting ground waters.
- Ecology and wildlife – Incorporation of measures to mitigate against potentially contaminated run-off e.g. bunding in areas of fuel and chemical storage, adoption of oil / silt interceptors in drainage design, control valves on outlet structures to ponds and drainage features etc.

14.4 Summary

14.4.1 The potential adverse effects of the Development related to ground contamination are assessed as the risk to Site workers during the construction works associated with any ground contamination and to ground / surface waters and ecology due to the potential migration of contaminants from construction activities. Effects of these risks will be mitigated through the implementation of appropriate mitigation measures.

14.4.2 As noted in the Scoping Opinion a soil management strategy will be prepared at the reserved matters stage and included in the CEMP.

14.4.3 It is therefore concluded that the adverse potential effects associated with ground contamination do not pose an unacceptable constraint to the Proposed Development and no significant environmental effects will arise.

15. Cumulative effects

15.1 Introduction

15.1.1 This chapter updates the cumulative effects assessment in the submitted ES to show the changes resulting from the amended Proposed Development. The chapter requires updating to reflect the amendments in the assessments undertaken as part of this addendum. The following sections remain unchanged from the submitted ES and have not been replicated within this document.

- Scope of assessment;
- Relevant legislation and policy;
- Method of assessment;
- Baseline conditions;
- Mitigation measures.

15.1.2 The following sections require updating to reflect the amended Proposed Development and are presented in this chapter:

- Impact assessment – Cumulative effects – Operational phase only;
- Summary.

15.2 Impact Assessment

Cumulative effects

Operational phase

15.2.1 Table 15.1 lists all those receptors that will be impacted during operation of the Proposed Scheme and notes any impacts from the other developments shown on Figure 10.1, summarising the potential for significant cumulative effects

Table 15.1 Operational phase cumulative effects assessment

Baseline		Impact assessment								
Receptor	**Value**	**Proposed Development**	**north west Cambridge**	**NIAB**	**Orchard Park**	**Northstowe**	**West Cambourne**	**Cumulative effect**	**Cumulative Impact magnitude**	**Significance of effect**
Designated ecological sites	National to local	Minor adverse effects will occur to Adams Road Sanctuary City Wildlife Site (CIWS) due to works in the upper reaches of Coton Brook impacting downstream water quality.	None	None	Potential to affect King's Hedges Hedgerow CIWS due to dust.	None	Negligible effect on designated sites due to intervening distances.	None of the developments will affect the same designated ecological site. Cumulative effects to any individual designated ecological site will not arise.	Negligible	Negligible **Not significant**
Habitats	Site	Minor adverse effects will occur to water bodies and green corridors on site during construction due to temporary habitat loss and impacts to water quality.	Adverse effect due to the loss of short sections of hedgerow.	Locally significant effects due to the loss of on-site arable farmland, scrub, ditches, ponds, and small sections of hedgerow.	Habitats within the site which will be lost are of negligible to site value.	Moderate adverse effect due to loss of grassland and arable habitats.	Minor to negligible effects due to the removal of hedgerows,	Across all sites existing habitats will inevitably be lost. The value of most habitats on Site is at the site or local level only and the most important habitats are the waterbodies and green corridor. Impacts to water bodies will be temporary whilst physical works are undertaken to increase their volume after which they will be restored and improved. This will not result in cumulative effects with the NIAB development where surface water bodies will be completely lost. The green corridor is orientated east-west and links the M11 Scrub CiWS with sites within the City such as the Adams Road Sanctuary CWS. It does not link to habitats north of Madingley Road which are effectively severed by the road. Temporary loss of the corridor during construction will not result in adverse cumulative effects and will be enhanced and improved after construction.	Negligible	Negligible **Not significant**
Protected species	Local	Minor adverse effects will occur to Badgers, bats, and birds during construction due to increased disturbance and loss of foraging habitats.	Adverse effect to great crested newts, common toads, badgers, breeding birds, and brown hares due to the loss of habitat.	Adverse effects to bats foraging on site due to construction lighting. Locally to district significant adverse effects to badgers, brown hare, and birds due to a reduction in foraging habitat. Positive and adverse effects to water voles.	Loss of habitats will impact bird populations on site.	Moderate adverse effects due to the loss of skylark nesting habitat.	Major to moderate adverse effect to skylark due to a loss of habitat, minor adverse effect to yellow wagtail due to habitat loss and disturbance, temporary moderate to minor beneficial effect to corn bunting and grey partridge due to phasing creating set aside land.	All developments have reported an adverse impact to birds during construction due to habitat loss and disturbance. Cumulative effects to birds are likely to occur particularly around the West Cambridge, North West Cambridge and NIAB sites which all located relatively closely. As all these sites are at the edge of the city there is ample habitat in the surrounding countryside for birds to be displaced to so the loss of habitat from these sites is a minor cumulative impact. The same applies to the local badger population at West Cambridge, North West Cambridge and NIAB.	Minor	Minor **Not significant**
Invasive species	No conservation value	Minor beneficial effect due to the treatment and removal of invasive species on Site.	None	None	None	None	None	No invasive species impacts have been reported on any of the other developments. No cumulative effects will arise.	Neutral	Neutral **Not significant**

Baseline		Impact assessment								
Receptor	**Value**	**Proposed Development**	**north west Cambridge**	**NIAB**	**Orchard Park**	**Northstowe**	**West Cambourne**	**Cumulative effect**	**Cumulative Impact magnitude**	**Significance of effect**
Conservation areas	High	Negligible to slight adverse effect to Central Cambridge Conservation Area, minor to moderate adverse effect to Conduit Head Road Conservation Area and minor adverse effect to West Cambridge Conservation Area due to the impact of the Proposed Development on their setting.	Negligible effects on Conservation Areas.	None	None	Medium to small change to the setting of Longstanton Conservation Area due to the increased presence of development, minor changes to key views, and loss of the agricultural context.	None	The Proposed Development will impact Central Cambridge Conservation Area, Conduit Head Road Conservation Area and West Cambridge Conservation Area. None of the other developments will impact these Conservation Areas so no cumulative effects will occur.	No change	Neutral Not significant
Listed buildings	Medium to high	Moderate adverse effect to White House grade II listed building Schlumberger Gould Research Centre grade II* listed building, and minor adverse effects to five other listed buildings due to the impact of the Proposed Development on their setting.	Moderate to minor adverse effects to one locally listed building, Ascension burial ground chapel, due to impacts to setting.	None	None	Negligible effects to two listed churches in Longstanton.	Moderate adverse effect to two scheduled monuments due to change in setting. Minor adverse effects to the non-designated Swansley Farm moated site due to a change in setting.	The Proposed Development will impact the setting of White House, Schlumberger Gould Research Centre and five other listed buildings. None of these will be impacted by any of the other developments so no cumulative effects will arise.	No change	Neutral **Not significant**
Landscape character areas (LCA)	Low to high	Large adverse effect to Coton, and Grantchester LCAs, large to moderate adverse effect to West Cambridge Central Core LCA, moderate adverse effect to Madingley LCA, and slight adverse effect to north west Cambridge, and High Cross LCAs due to the urbanising effect of the Proposed Development.	Minor adverse effects to Regional Character Area 3 – Western Claylands, major adverse effects to LCA 5 and minor adverse effects to LCA 2 due to re-definition of the western urban edge of Cambridge.	Slight beneficial impact to Southern Fen Edge LCA., Western Arbury and King's Hedges LCA, and Huntingdon Road LCA due to improved landscape design on the site.	None	Slight adverse effects to Lowland Village Farmlands LCA, Planned Silt Fen LCA, Planned Peat Fen LCA, and Wooded Village Farmlands due to visibility of development.	Negligible effect due to screening planting.	All of the developments will result in an increase in urban development in the north west of Cambridge. Northstowe and West Cambourne are sufficiently distant from Cambridge so as to not affect the city's urban expansion. The Proposed Scheme combined with north west Cambridge, NIAB, and Orchard Park collectively represent a significant urban extension to the north west quadrant of Cambridge by extending the urban environment towards the green belt. The cumulative magnitude of impact for this urban extension is large adverse.	High adverse	Moderate to large adverse (depending on LCA) **Significant**

Baseline		Impact assessment								
Receptor	**Value**	**Proposed Development**	**north west Cambridge**	**NIAB**	**Orchard Park**	**Northstowe**	**West Cambourne**	**Cumulative effect**	**Cumulative Impact magnitude**	**Significance of effect**
Key viewpoints	Low to high	Large adverse effects to two viewpoints, large to moderate adverse effects to two viewpoints, moderate adverse effects to three viewpoints, moderate to slight adverse effects to five viewpoints, and slight adverse effects to six viewpoints due to the introduction of new urban elements into existing views.	Minor adverse effects to nine viewpoints, moderate adverse effects to one viewpoint, and major adverse effects to two viewpoints due to the introduction of new urban elements into existing views.	Slight adverse effects to six viewpoints fifteen years after construction due to an urbanising effect on views.	None	Slight adverse effects to nine viewpoints, moderate adverse effects to four viewpoints, substantial adverse effects to nine viewpoints, and very substantial adverse effects to three viewpoints due to the proposed scheme appearing in views.	Moderate adverse to negligible effects due to varying degrees of views being impinged by the proposed scheme.	With the exception of Orchard Park all of the developments will result in adverse effects to visual receptors. The only visual receptor impacted by the Proposed Scheme which also has views of the other developments is Viewpoint 1 at the Coton Countryside Reserve which has commanding views of both the Site and the north west Cambridge site. The combination of both developments within this view will increase the perception of urban encroachment resulting in cumulative effects on this high value viewpoint.	Medium adverse	Moderate adverse **Significant**
Employment	Medium	Moderate beneficial effects will arise due to the direct and indirect creation of 1,000 jobs at the local level and 1,200 jobs at the regional level.	Significant benefits will arise due to job creation during construction. It is expected many of these will be sourced nationally resulting in leakage.	Beneficial effect due to job creation during construction. It is anticipated these jobs will mainly be sourced from outside of the region.	None	Small beneficial effects will arise from the direct employment of up to 250 construction workers on-Site. Likely to be a mix of local workers and workers from further afield.	Moderate to minor beneficial effects due to the creation off 331 construction jobs per month.	All of the developments will result in an increase in construction work opportunities although as not all the developments have quantified the predicted number of construction workers required this is difficult to quantify. As the construction programmes of all the developments are likely to overlap to some degree, given the large time scales involved, there is likely to be a cumulative benefit to employment. The construction sector in Cambridge and South West Cambridge is generally under represented compared to national averages so the cumulative benefits of this increased employment is likely to be felt outside the region.	Moderate beneficial	Moderate beneficial Significant
Local economy	Moderate	Minor beneficial effects to the local economy will result due the use of local supply chains and construction worker expenditure.	Not directly assessed but assumed to be beneficial due to increased employment, supply chains, worker expenditure etc.	Not directly assessed but assumed to be beneficial due to increased employment, supply chains, worker expenditure etc.	None	Not directly assessed but assumed to be beneficial due to increased employment, supply chains, worker expenditure etc.	Not directly assessed but assumed to be beneficial due to increased employment, supply chains, worker expenditure etc.	Although employment benefits from construction are likely to be mainly felt outside the region, a proportion of new construction jobs will be catered for by local demand. In addition there will be the local economic benefits of supply chains, and businesses catering for construction workers. There will be a cumulative benefit to the local and regional economy from all of the developments collectively.	Low beneficial	Minor beneficial Not significant
Local residents / businesses	Moderate	Minor adverse effects to local businesses and residents will arise during construction due to temporary disruption.	None	None	None	None	None	No other developments anticipated effects to local residents and businesses so cumulative effects to these receptors are unlikely to arise.	Negligible	Negligible Not significant
Security	Low	Negligible security effects will occur as the work site will remain secure and guarded throughout construction.	None	None	None	None	None	No other developments anticipated effects to security so cumulative effects are unlikely to arise.	Negligible	Negligible Not significant
Housing and services	Low	Negligible adverse effects to housing and services will result from increased demand from construction workers.	None	None	None	None	Negligible	No other developments anticipated effects to housing and services so cumulative effects to these receptors are unlikely to arise.	Negligible	Negligible Not significant

Baseline		Impact assessment								
Receptor	**Value**	**Proposed Development**	**north west Cambridge**	**NIAB**	**Orchard Park**	**Northstowe**	**West Cambourne**	**Cumulative effect**	**Cumulative Impact magnitude**	**Significance of effect**
Dust receptors	Medium	Negligible effects from dust will occur due to effective implementation of standard mitigation measures.	Negligible effects from dust will occur with mitigation in place.	None	Minor to negligible adverse effects to residential and school receptors with mitigation.	Moderate adverse effects to residential receptors and schools within 200m of construction works.	Negligible effects from dust will occur due to effective implementation of standard mitigation measures.	With the exception of Northstowe, all projects are predicted to result in negligible or minor effects from dust due to the implementation of effective standard mitigation measures. At Northstowe only receptors within 200m of dust generating activities will be impacted. As the Site is substantially further than 200m from Northstowe none of the receptors impacted by Northstowe could be impacted by the Proposed Development	No change	Negligible Not significant

15.3 Summary

15.3.1 Changes to individual receptors as a result of the amended Proposed Development have not resulted in any overall change to the conclusions of the cumulative effects chapter. Significant adverse cumulative effects still result to landscape character areas and visual receptors.

16. Schedule of mitigation

16.1.1 Table 16.1 below provides a summary of all the updated mitigation measures sections where these have been amended. It does not include the mitigation measures in chapters that did not require the mitigation measures sections to be updated so should be read in conjunction with the schedule of mitigation in the submitted ES. The chapters which have updated mitigation measures are:

- Historic environment;
- Landscape and visual;
- Traffic and transport;
- Air quality
- Noise and vibration
- Water environment
- Ground conditions.

Table 16.1 Schedule of proposed mitigation measures

Assessment chapter	Mitigation measure	Secured through:
Historic environment	As confirmed by the 2011 Whittle Laboratory excavations (Slater 2011), the north western side of the Vicar's Farm Roman settlement extends into the eastern portion of that facility's grounds. This will require excavation over approximately 3,375m^2. Of this, excluding the 2011-area, approximately 2,100m^2 lie exterior to that building's footprint and will require full excavation prior to the Laboratory's demolition; occurring within the footprint-area, the remaining portion (approximately1,275m^2) will require more summary investigation concurrent with the Laboratory's demolition.	Planning condition
	A limited degree of Iron Age occupation evidence was found during the course of the 2001 Nano-Fabrication Building Site investigations. The settlement is likely to have extended across at least part of the area of the Cavendish Laboratory complex, but where it was unfeasible to cut any trial trenches during the 2015 evaluation programme. Accordingly, upon vacating the Laboratory buildings (but prior to their demolition), a limited trenching programme will be conducted within the grounds; should further evidence of early settlement be recovered, then an appropriate excavation programme will occur in conjunction with the demolition works.	Planning condition
	Site 2 will require full open-area excavation when development proceeds there. The further investigation of the Site 3 field system and trackway – aside from its incidental exposure in Site 2 – can, within Field 1, be limited to the area of new major building footprints and any further areas that will be disturbed through excavation, augmented by additional trenching.	Planning condition
	Nano-Fabrication Building Site - A limited degree of Iron Age occupation evidence was found during the course of the 2001 investigations[20]. The settlement is likely to have extended across at least part of the area of the Cavendish Laboratory complex, but where it was unfeasible to cut any trial trenches during the 2015 evaluation programme. Accordingly, upon vacating the Laboratory buildings (but prior to their demolition), a limited trenching programme will be conducted within the grounds; should further evidence of early settlement be recovered, then an appropriate excavation programme will occur in conjunction with the demolition works.	Planning condition
	The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m.	Approval (Design Guidelines)
	At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45°angle to the parameter height of 31 m AOD.	Approval (Design Guidelines)
	Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site.	Approval (Design Guidelines)
	Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development.	Approval (Design Guidelines)
	Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing.	Approval (Design Guidelines)
	Treatment of façades shall be sensitive in scale and the use of materials.	Approval (Design Guidelines)
	Woodland infill planting at the site edges shall be native trees and shrubs and shall be in accordance with the Woodland Management Plan, Appendix 8.4, Volume 3.	Approval (Design Guidelines)
	The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3).	Approval (Design Guidelines)
	Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge.	Approval (Design Guidelines)
	Rooftop plant shall be set back from the predominant building line adjacent to Clerk Maxwell Road or effectively screened.	Approval (Design Guidelines)

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Assessment chapter	Mitigation measure	Secured through:
	External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings.	Approval (Design Guidelines)
	The Listed Schlumberger Research building shall remain the primary landmark for the site. New development and spaces shall work together to define a new and appropriate setting for this building.	Approval (Design Guidelines)
	A view corridor with a minimum 20m width will be preserved between JJ Thomson Avenue and High Cross to protect views through the Site of the Schlumberger Research Building.	Approval (Design Guidelines)
	On the west side of High Cross, the Listed Schlumberger Research building shall remain visible as a key site landmark.	Approval (Design Guidelines)
	In the central part of High Cross Avenue, a zone of lower development height shall be established to maintain the views of the Schlumberger Research building roof structure. The exact positioning of this lower zone shall be such to allow views of the roof-line (tent structure) from The Green.	Approval (Design Guidelines)
	Rooftop plant shall not be located within the 32m AOD zone along Madingley Road.	Approval (Design Guidelines)
	Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road.	Approval (Design Guidelines)
Landscape and visual	Vegetation on Site that will be retained will be protected from accidental damage during construction by erecting temporary fencing.	Planning condition
	Temporary hoarding will be used around all construction compounds and work sites to screen views of construction activities.	Planning condition
	The use of security lighting during construction will be minimised. Where it is needed Institute of Lighting Engineers guidance will be followed to minimise light spill.	Planning condition
	Construction traffic travelling to and from the Site will travel along haul routes agreed with Cambridgeshire County Council. The haul routes will avoid Cambridge city centre and Madingley Road west of the M11 where possible.	Planning condition
	Mitigation measures to minimise construction noise and dust will help to preserve the tranquil character of the adjacent landscape character areas.	Planning condition
	Operation of a clean and tidy construction site, including covering of stockpiles.	Planning condition
	Existing north-south streets shall be further greened through the use of development setbacks and landscaped areas formed alongside High Cross and Western Access/Ada Lovelace Road.	Approval (Design Guidelines)
	The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m – The frontages longer than 50m shall employ at least one of the strategies described in Figure 24 of the Design Guidelines for breaking the long frontages. The choice of one or more of the strategies will depend on the location on the site: some strategies will be better suited for the site edges (for example using planting adjacent to woodland buffers) others will be required along streets or key spaces (for example varying roof lines and building lines).	Approval (Design Guidelines)
	Lengths of unbroken frontages on multi storey car parks shall be limited to 50m – Frontage lengths of multi storey car parks longer than 50m shall be broken by introducing one or more of the strategies and/or other measures described in in Figure 25 of the Design Guidelines, which achieve the effect of introducing variety and breaking down the frontage length.	Approval (Design Guidelines)
	Maximum build-to lines along High Cross Avenue shall be setback from the road corridor by at least 8m on the eastern side and by at least 5m on the western side of the street – Thus, together with the road corridor of 25.3m, the width between buildings along High Cross shall be minimum 38.3m in the south and 44.8m minimum in the north.	Approval (Design Guidelines)
	At the southern end of High Cross Avenue, an additional frontage height restriction of 33m AOD (to the west) and 35m AOD (to the east) shall be applied. Any development above these heights shall be set back by a minimum of 5m from the primary frontage line.	Approval (Design Guidelines)
	Building Zones along JJ Thompson Avenue are set to allow for a 10m buffer between the stems of the existing trees and the proposed building faces (maximum Build to Line) – This provides an additional zone of minimum 4m between the edge of the road corridor and the building faces on each side. Thus, together with the road corridor width of 25.3m, the width between buildings along JJ Thomson Avenue shall be minimum 33.3m.	Approval (Design Guidelines)
	Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site.	Approval (Design Guidelines)
	Frontages facing the southern landscape shall have a high quality architectural treatment and materials. Materials and facade design shall respond to this south facing location.	Approval (Design Guidelines)
	Primary frontages shall be of high quality design and be well articulated with fenestration, other façade elements and/or use of materials.	Approval (Design Guidelines)
	The development of continuous roof lines of consistent height along the key spaces, streets and Green Links shall be avoided and preference shall be given to compositions with varying roof lines and accents.	Approval (Design Guidelines)
	Development along the Southern Edge shall respond to long distance views. Long frontages here shall be broken/varied and additional tree planting and landscape shall be introduced to provide a softer, woodland edge.	Approval (Design Guidelines)
	Along the Southern edge additional height restrictions and setbacks apply, as shown in Figures 166 and 167 of the Design Guidelines – frontages adjacent to the southern boundary shall not exceed 31m AOD.	Approval (Design Guidelines)
	At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45°angle to the parameter height of 31 m AOD.	Approval (Design Guidelines)
	Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development.	Approval (Design Guidelines)

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Assessment chapter	Mitigation measure	Secured through:
	Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing.	Approval (Design Guidelines)
	Some research buildings will have greater requirements for servicing areas and/or sensitive technical areas which will result in some blank façades. These blank façades shall provide variation and interest through use of setbacks, varied roofline and use of materials and planting.	Approval (Design Guidelines)
	Treatment of façades shall be sensitive in scale and the use of materials.	Approval (Design Guidelines)
	Materials for less visible façades shall be robust and designed to age well.	Approval (Design Guidelines)
	Planting at the West Forum shall reinforce the visual connection from the upper areas to the wider landscape and the Southern Ecological Corridor.	Approval (Design Guidelines)
	Existing mature planting and hedgerows within the East Pond area and along the Southern edge shall be maintained with the appropriate tree buffer zone. New tree planting shall be accommodated within the East Pond space (to the north of the pond) to ensure that new development is set within landscape.	Approval (Design Guidelines)
	Large feature tree planting shall be provided at a minimum of 5 key locations within The Green public open space area, such as at the gateways to The Green or key nodes within the space – Where large trees are planted they shall be given the proper environmental conditions and space to grow to maturity.	Approval (Design Guidelines)
	Large feature tree planting shall be provided at a minimum of 5 key locations along the Southern edge – Where these trees are planted they shall be given the proper environmental conditions and space to grow to maturity and shall be provided with a 15m buffer, in accordance with the Woodland Management Plan (Appendix 8.4, Volume 3).	Approval (Design Guidelines)
	Supplemental new planting to the Southern edge must be provided to ensure a soft edge to the Site and a transition from the Site to open countryside.	Approval (Design Guidelines)
	Large feature tree planting shall be incorporated at key locations along High Cross, such as: the gateway to Madingley Road and the interface with The Green – Large tree species must be given the proper environmental conditions and space to grow to maturity.	Approval (Design Guidelines)
	Large feature tree planting shall be incorporated at key spaces along JJ Thompson Avenue such as the gateway to Madingley Road and the interface with The Green – Large tree species shall be given the proper environmental conditions and space to grow to maturity.	Approval (Design Guidelines)
	The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development – The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3).	Approval (Design Guidelines)
	Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge.	Approval (Design Guidelines)
	Any new landscaped gaps between buildings along the western edge shall be a minimum of 20m from building face to building face.	Approval (Design Guidelines)
	The impact of plant (and rooftop plant in particular) on building design and on open spaces shall be carefully considered from the concept stage of design.	Approval (Design Guidelines)
	Wherever possible, plant shall be placed on roofs in locations where it will not be visible from the public realm.	Approval (Design Guidelines)
	Any plant required to be provided as a separate structure shall not be located next to or within the key open spaces.	Approval (Design Guidelines)
	Screening or parapets around plant locations shall be employed to reduce visibility of plant locations and reduce clutter.	Approval (Design Guidelines)
	Long distance views shall be considered in the location of plant.	Approval (Design Guidelines)
	Plant should be considered as a way to add variation and interest in the roofscape.	Approval (Design Guidelines)
	Medium and large plant shall be considered as part of architectural concepts and building massing as an additional storey of the building. The roof plant will unavoidably be visible from public realm and so shall be treated with appropriate materials.	Approval (Design Guidelines)
	Visual impact of large plant areas shall be reduced by breaking their volume and providing variation in rooflines.	Approval (Design Guidelines)
	Any parts of building facade related to plant shall not be inferior to the rest of the facade in materials and treatment.	Approval (Design Guidelines)
	If larger flues are required, they shall be treated as part of the architectural concept design and placed in locations that don't overwhelm key open spaces.	Approval (Design Guidelines)
	Where service areas, multi storey car parks and development 'backs' are located along the edges, they shall be screened by the existing woodland buffer, supplemented where necessary with additional planting and sensitively designed.	Approval (Design Guidelines)
	Rooftop plant shall be set back from the Southern Building Zone edge and there shall be effective screening of all rooftop plant, when viewed from the south.	Approval (Design Guidelines)
	Any new artificial lighting to buildings or spaces shall ensure that impacts of lighting on and offsite meet the Institute of Lighting Professionals – Guidance Notes for the Reduction of Obtrusive Light – GN01:2011 for the appropriate environmental zone.	Approval (Design Guidelines)
	An artificial lighting scheme shall be submitted with each reserved matters application.	Approval (Design Guidelines)
	Screening vegetation along the boundaries of the Site will be managed in accordance with the Woodland Management Plan.	Planning condition
	Rooftop plant shall not be located within the 32m AOD zone along Madingley Road.	Approval (Design Guidelines)

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Assessment chapter	Mitigation measure	Secured through:
	Any rooftop plant within the 37m or 41m AOD zone along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road.	Approval (Design Guidelines)
	The three north-south running streets and the Central Green Link shall have building to building width with a minimum of 30m.	Approval (Design Guidelines)
Traffic and transport	Delivery routes will be agreed with the local highways authority and will preferentially access the Site from the M11 Junction 13/ Madingley Road particularly for heavy vehicles.	Planning condition
	Heavy vehicle movements will not be permitted through Cambridge City unless no alternative is available and only once agreement has been sought with the local highway authority.	Planning condition
	The travel demand management strategy, set out in the Framework Travel Plan based on: • The benefit of a fully-funded quality FTP; • The consequences of the application of "Smarter Choices" guidance to reduce vehicular trip generation from the Proposed Development; and • The provision of car parking at a controlled, appropriate level of provision, and the implementation of a car parking management scheme combined with permit provision on a demonstrated needs basis;	Section 106 agreement / planning condition
	An enhanced public transport strategy. The scale of the Proposed Development means that there will be both a high quantum of demand for public transport, and a number of locations that will need to be connected to West Cambridge. The strategy, detailed within Section 7 of the Transport Assessment, includes: • Increased regularity of bus provision; • Direct on-site routes; • Provision of high quality bus stops (including real time passenger information, and the provision of comprehensive timetable information including network maps and fare details); • Bus priority measures to be provided with Selective Vehicle Detection technology at any new traffic signals controlling the entrances to the Site from Madingley Road; • Provision of service information and incentive measures to increase patronage; and • Promote network ticketing with operators serving West Cambridge, allowing for passengers from destinations other than Cambridge city centre to make journeys on other services and transfer using the same ticket stored on a smartcard, mobile phone or EMV wave and pay card.	Section 106 agreement / planning condition
	Quality pedestrian and cyclist facilities. The strategy, detailed within Section 6 of the Transport Assessment, includes: • Direct, quality North-South footway and cycleway provision across West Cambridge linking between Madingley Road and Coton Path using the Western Access, High Cross, JJ Thomson Avenue and Clerk Maxwell Road.; • The East - West Shared Space Link to provide the main east - west spine for Pedestrians and Cyclists connecting Clerk Maxwell Road and High Cross with access to a number of plots and lower-hierarchy Cycle routes; • As with north west Cambridge, all vehicle routes being designed for a 20mph speed limit using passive speed management measures such as constrained widths and the use of shared surface areas. This low-speed environment is primarily to control vehicle speeds, but in so doing will create a safer and more attractive environment for pedestrians and cyclists; • Footways being provided on both sides of the on-site streets and at the Site Access locations. Controlled crossing points would be provided, and traffic calming measures would be present to reduce traffic speed and to ease pedestrian movement; • Improved links between West Cambridge and all popular destinations; including to the East, towards the City, and to the north through north west Cambridge. These links will be supported with controlled crossings; • Provision of high levels of quality cycle parking, at least to the adopted Cambridge Local Plan 2014 minimum cycle parking standards, within private covered, secure, lit and well-located areas at the destinations, as well as further provision through the Development; and • All major employers being encouraged to provide associated shower and changing room facilities for walkers and cyclists after their journeys.	Section 106 agreement / planning condition
	Schemes to improve environmental conditions. The strategy, identified in Section 16 of the Transport Assessment, includes: • Contributions to effect a lower speed limit than the existing 40mph speed limit locally on Madingley Road – thus providing environmental benefit from existing vehicular movements; • Contributions to the necessary Traffic Regulation Orders to implement car parking zones or prohibitions on surrounding streets to minimise inappropriate overspill parking – potentially in the context of providing improved cycle facilities; • Measures at three locations to address existing highway safety concerns – especially effecting vulnerable road users; • The extension of the SCOOT and MOVA traffic signal optimisation to the proposed traffic signals along Madingley Road – JJ Thomson Avenue and Clerk Maxwell – to control any additional queuing and delays as a consequence of the Proposed Development.	Section 106 agreement / planning condition
	Guaranteeing funding for potential highway mitigation schemes that could be implemented should the cyclic monitoring strategy identify that conditions deteriorate significantly at: • Madingley Road / High Cross junction; and • Madingley Road / Clerk Maxwell Road junction.	Section 106 agreement / planning condition

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Assessment chapter	Mitigation measure	Secured through:
	Adaptive phase approach through which a mitigation scheme will be delivered at the appropriate time, and ensured through a planning condition, which sets out: • The mitigation scheme's objectives including the targets it must meet over time; • The mitigation scheme's parameters; • The methods of achieving the mitigation scheme's objectives and reviewing and adapting those methods over time to ensure that the objectives are met; and • A review mechanism to ensure that the achievement of the objectives is kept under review and the methods adapted if further steps prove necessary. The likely mitigation strategy is anticipated to consist of: • To control and reduce vehicle trip generation: - Provision of appropriate levels of car parking on-site, with delivery phased to reflect development implementation; - managing the on-site car parking provision; and - review of car parking off-site, offer of further parking control measures if required. • To preserve conditions: - offer contributions to the delivery of a further reduction in the Madingley Road speed limit; and - review road safety and promote further local schemes if required. • To improve conditions for pedestrians and cyclists on-site: - quality footway / cycleway infrastructure; - high levels of conveniently located quality cycle parking; - all major occupiers providing shower and changing room facilities; and - managing cycle parking provision. • To improve conditions for pedestrians and cyclists off-site: - providing remedial measures to assist in resolving any identified emerging road safety issues; - improved crossing at Eddington Avenue; - improved facilities along the Corridor to the City Centre – along Grange Road, West Road, Queen's Green and Silver Street; and - contributions to the delivery of a further reduction in the Madingley Road speed limit. • To enhance Public Transport on-site: - provide selected vehicle detection for buses through traffic signal controlled junctions to provide bus priority; and - provide information and incentives to the site occupiers. • Enhanced bus services: - Citi 4 - increased frequency to every 10 minutes; - Universal – possibly introduce an extended orbital service to Addenbrooke's Hospital; or - Arc Service – increased frequency, and possibly extend service further to South Cambridge; - review a new variation of the Service B on the Guided Busway. • Enhancing travel demand management: - locate further Car Club vehicles on-site; - review cycling initiatives – including cycle pools, cycle buddy, training, discounted equipment; and - marketing and promotion. • To preserve local highway capacity, consider physical interventions: - provide localised highway enhancement to accommodate the new Western Access Road junction; and - consider further highway mitigations, if required. • To preserve strategic highway capacity, consider Corridor interventions: - work together with the Highway and Planning Authorities to deliver interventions strategically	Section 106 agreement / planning condition
Air quality	Develop and implement a stakeholder communications plan which displays the name and contact details of persons accountable, and the head or regional office information on the site boundary.	Planning condition
	Develop and implement a dust management plan.	Planning condition
	Record all dust and air quality complaints, identify causes and take measures to reduce emissions.	Planning condition
	Record exceptional incidents and action taken to resolve the situation.	Planning condition
	Carry out regular site inspections to monitor compliance with the dust management plan and record results.	Planning condition
	Increase site inspection frequency during prolonged dry or windy conditions and when activities with high dust potential are being undertaken.	Planning condition

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Assessment chapter	Mitigation measure	Secured through:
	Agree dust monitoring locations with the local authority and instigate monitoring 3 months in advance of works commencing in the area.	Planning condition
	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible.	Planning condition
	Erect solid screens or barriers around dusty activities or the site boundary at least as high as any stockpile on site.	Planning condition
	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	Planning condition
	Avoid site run off of water or mud.	Planning condition
	Keep site fencing, barriers and scaffolding clean using wet methods.	Planning condition
	Remove potentially dusty materials from site as soon as possible.	Planning condition
	Cover, seed or fence stockpiles to prevent wind whipping.	Planning condition
	Ensure all vehicles switch off engines when stationary.	Planning condition
	Avoid the use of diesel or petrol powered generators where possible.	Planning condition
	Produce a Construction Logistics Plan to manage the delivery of goods and materials.	Planning condition
	Only use cutting, grinding and sawing equipment with dust suppression equipment.	Planning condition
	Ensure an adequate supply of water on site for dust suppressant.	Planning condition
	Use enclosed chutes and conveyors and covered skips.	Planning condition
	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use water sprays on such equipment where appropriate.	Planning condition
	Ensure equipment is readily available on site to clean up spillages of dry materials.	Planning condition
	No on-site bonfires and burning of waste materials on site.	Planning condition
	Re-vegetate earthworks and exposed areas /soil stockpiles to stabilise surfaces as soon as practicable.	Planning condition
	Only remove the cover in small areas during work and not all at once.	Planning condition
	Incorporate soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	Planning condition
	Ensure water suppression is used during demolition operation.	Planning condition
	Avoid explosive blasting, using appropriate manual and mechanical alternatives.	Planning condition
	Bag and remove any biological debris or damp down such material before demolition.	Planning condition
	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless required for a particular process.	Planning condition
	Ensure bulk cement and other fine powder materials are delivered in enclosed tanker sand stored silos with suitable emissions control systems.	Planning condition
	Use water assisted dust sweepers on the site access and local roads.	Planning condition
	Avoid dry sweeping of large areas.	Planning condition
	Ensure vehicles entering and leaving the site are covered to prevent escape of materials.	Planning condition
	Record inspection of on-site haul routes and any subsequent action, repairing as soon as reasonably practicable.	Planning condition
	Install hard surfaced haul routes which are regularly damped down.	Planning condition
	Install a wheel wash with a hard-surfaced road to the site exit where site layout permits.	Planning condition
	The site access gate to be located at least 10m from receptors where possible.	Planning condition
	Further assessment will be required at detailed design to identify potential laboratory emissions. The assessment will inform any abatement that may be required to ensure significant adverse effects do not arise	Planning condition
Noise and vibration	Breaking out of concrete structures would be undertaken, where possible, using low noise effect methods including bursting and splitting rather than percussive breaking.	Planning condition
	Detailed programming of works to make maximum use of existing barriers to noise.	Planning condition

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Assessment chapter	Mitigation measure	Secured through:
	Retention of the outer walls of structures for as long as possible before demolition is necessary.	Planning condition
	Careful selection of demolition/construction methods and plant to be used.	Planning condition
	Switching off of plant and vehicle engines when not in use.	Planning condition
	Restriction of drop heights onto lorries.	Planning condition
	Regular maintenance and servicing of vehicles, equipment and plant.	Planning condition
	Appropriate handling and storage of materials.	Planning condition
	Appropriate operational hours (to be agreed with the local authority).	Planning condition
	Enforcement of restricted working hours for excessively noisy activities.	Planning condition
	Implementation of an appropriate traffic management strategy.	Planning condition
	Use of temporary acoustic barriers where appropriate and other noise containment measures such as screens, sheeting and acoustic hoardings at the construction site boundary to minimise noise breakout and reduce noise levels at the potentially affected receptors.	Planning condition
	Agreement with Cambridge City Council and neighbours on suitable approach to noisy activities if a temporary source of noise cannot reasonably be prevented and the works being undertaken are crucial to progressing the particular project phase.	Planning condition
	Keep neighbours and stakeholders (including the existing commercial and university occupants as well as nearby residential inhabitants) informed about construction activities. Measures for community liaison would be dealt with by a dedicated Community Liaison Officer to co-ordinate the dissemination of information (for example, by means of a regular newsletter) and to program those operations at time that would minimise the potential for disturbance.	Planning condition
	Precise details and locations of vibration sensitive equipment or long-term vibration sensitive experiments are unknown at this stage. Additionally, some buildings which are likely to house vibration sensitive uses, such as the Cavendish Laboratory, are scheduled for demolition as part of the masterplan. Once a demolition and construction programme is available, suitable vibration limits and the requirement for vibration monitoring will be determined. This could include the following measures: • Specification in the CEMP for further measures; • Further investigation into existing vibration levels; • Setting vibration limits; and Continuous vibration monitoring	Planning condition
	Plant will be selected, located and attenuated so that planning conditions attached to the development by Cambridge City Council are satisfied. This is likely to require meeting noise limits provided in Table 3.12 at nearby receptors through a combination of the following environmental noise control techniques which could be implemented: • Enclosing noisy plant within the building envelope; • Selecting suitably quiet 'low noise' plant; • Positioning air intake/discharge louvres away from noise sensitive receptors; • Orientating air intake/discharge louvres away from noise sensitive receptors; • Attenuation of air intake/discharge louvres with duct mounted attenuators; and • Sound insulating plant housings/enclosures.	
	As the Energy Centre could be housed within a building, particular attention to the orientation and attenuation of air intake / discharge louvres and flues will be considered at detailed design.	
Ground conditions	The risk to Site workers during the construction works relates to the risk of skin contact, inhalation and ingestion of contaminated material on Site. In accordance with current health and safety legislation, the contractor will be required to adopt the following measures to mitigate the risk to Site workers, and these will be incorporated in the CEMP: • Appropriate protective clothing and equipment will be worn by site workers; and good standards of hygiene adopted to prevent prolonged skin contact, inhalation and ingestion of soils during construction; • In addition, the methods of working will be selected to limit the potential for air-borne dust to arise associated with the excavation and disturbance of the soils present on the Site; • Ensure workers at risk of encountering potentially hazardous materials have had appropriate training • As part of the CEMP, a watching brief for the visual and olfactory assessment of the soil quality will be maintained with sampling and testing for verification and assessment purposes where necessary, together with treatment as required.	Planning condition
	Methods of working will be selected to limit the potential for air-borne dust to arise associated with the excavation and disturbance of the soils present on the Site. These are detailed in Chapter 11 (refer to the submitted ES) and will be specified within the Soils Management Strategy which will form part of the CEMP.	Planning condition

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Assessment chapter	Mitigation measure	Secured through:
	Implementation of standard environmental protection measures during construction set out in CIRIA C532 and the Environment Agency's former Pollution Prevention Guidance (PPG) series as further detailed in Chapter 13 water environment (refer to the submitted ES). Preparation of appropriate application documents and associated assessments and adherence to Environment Agency consent and licence requirements for any proposed engineering works (e.g. for possible open loop ground source heat pumps) penetrating the base of the Gault Clay and abstracting groundwater from the underlying strata and/or discharging into the same strata.	Planning condition
	Further to the results of future ground investigation, appropriate gas protection measures may be required in new buildings.	Planning condition
	The risk to Site workers during any subsequent maintenance works relates to the risk of skin contact, inhalation and ingestion of any residual as yet undetermined contaminated material on Site. In accordance with current health and safety legislation, the maintenance contractor will be required to adopt measures to mitigate the risk to Site workers.	Planning condition
	The placement of buildings / hardcover, as well as replacement of the existing surface water drainage system will mitigate against the risk of potential mobilisation / migration of any residual potential contaminants. The removal and / or remediation of any contamination sources discovered, together with any localised remedial action necessary, will reduce the risk of migration of contaminants impacting ground waters.	Planning condition
	Incorporation of measures to mitigate against potentially contaminated run-off e.g. bunding in areas of fuel and chemical storage, adoption of oil / silt interceptors in drainage design, control valves on outlet structures to ponds and drainage features etc.	Planning condition

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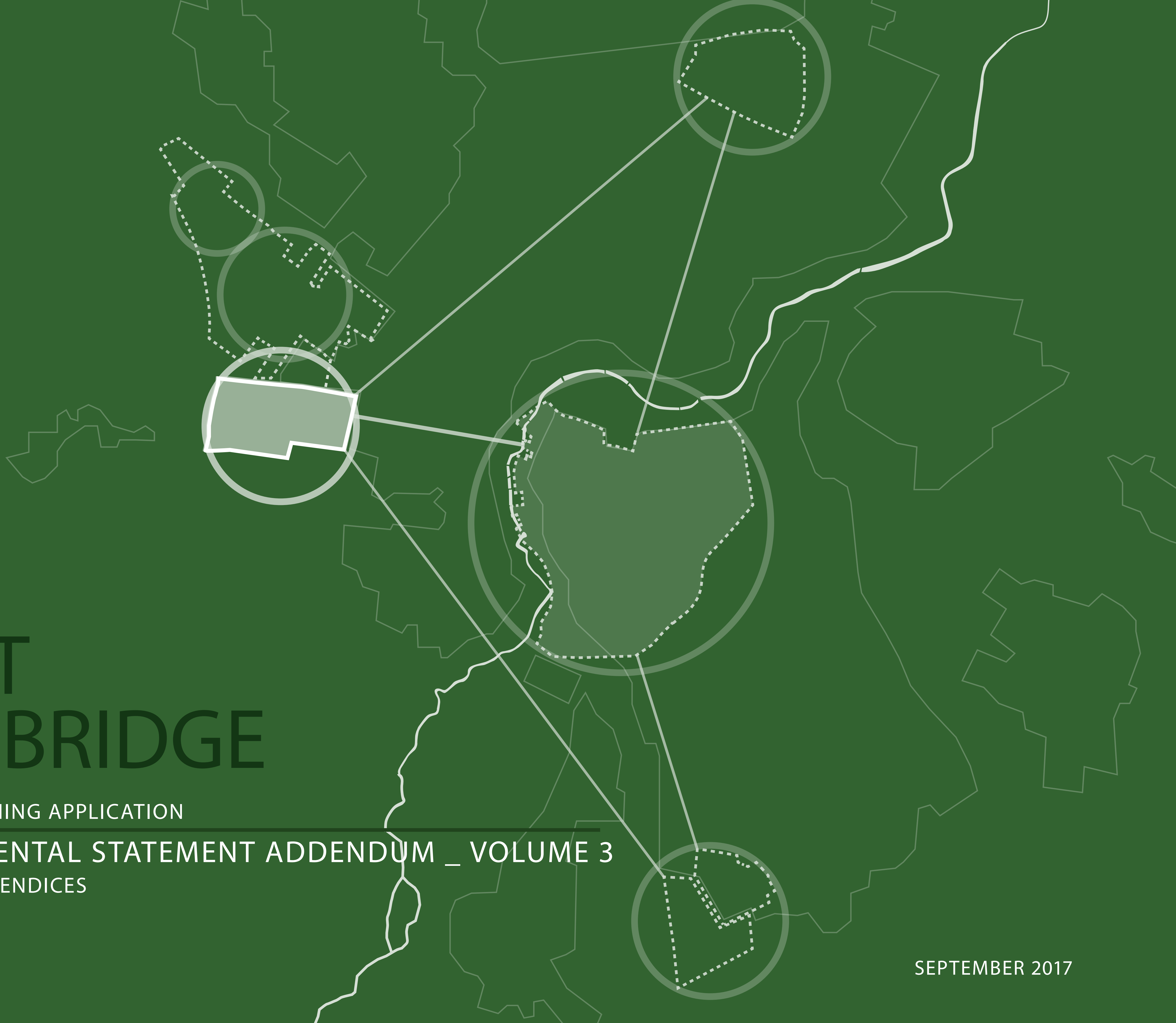

WEST CAMBRIDGE

OUTLINE PLANNING APPLICATION

ENVIRONMENTAL STATEMENT ADDENDUM _ VOLUME 3

TECHNICAL APPENDICES

UNIVERSITY OF CAMBRIDGE

SEPTEMBER 2017

Notice

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Document History

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Rev 1.0	Final	DP	DO'K	PMW	PMW	Aug 17
Rev 2.0	Final	DP	DO'K	PMW	PMW	Sep 17

EIA Quality Mark

This Environmental Statement and the Environmental Impact Assessment (EIA) carried out to identify the significant environmental effects of the proposed development have been undertaken in line with our commitments as members of the EIA Quality Mark.

The EIA Quality Mark is a voluntary scheme operated by the Institute of Environmental Management and Assessment (IEMA) through our EIA activities are independently reviewed, on an annual basis, to ensure we continue to deliver excellence in the following areas:

EIA Management
EIA Team Capabilities
EIA Regulatory Compliance
EIA Context & Influence
EIA Content
EIA Presentation
Improving EIA practice

To find out more about the EIA Quality Mark and our registration to it please visit: www.iema.net/qmark

Contents

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Introduction

As a result of the amended Proposed Development, a number of the appendices which formed part of the submitted ES require updating. These are listed below and are included in this volume and should replace the Appendices of the same number which were part of the submitted ES.

- Appendix 7.2 – Full historic environmental impact assessment – Built heritage only. Archaeology remains unchanged.
- Appendix 8.1 – Arboricultural impact assessment – Replaces the previously submitted Appendix 8.1.
- Appendix 8.3 – Visualisations – Replaces the previously submitted Appendix 8.3.
- Appendix 8.4 – Woodland management plan – This is a new appendix which did not form part of the submitted application.
- Appendix 9.1 – Employment calculations – Replaces the previously submitted Appendix 9.1.
- Appendix 10.1 – Construction traffic assessment – Replaces the previously submitted Appendix 10.1.
- Appendix 10.3 – Traffic flows – Replaces the previously submitted Appendix 10.3.
- Appendix 10.4 – TEMPRO growth factors for the Cambridge area – This is a new appendix which did not form part of the submitted application.
- Appendix 11.1 – Human health receptors – Replaces the previously submitted Appendix 11.1.
- Appendix 11.2 – Air quality model verification – Replaces the previously submitted Appendix 11.2.
- Appendix 11.3 – Traffic data used of the assessment – Replaces the previously submitted Appendix 11.3.
- Appendix 11.5 – Predicted concentrations of air quality emissions at baseline receptors – Replaces the previously submitted Appendix 11.5.
- Appendix 11.6 – Predicted future concentrations of air quality emissions for impact scenario (human health receptors) – Replaces the previously submitted Appendix 11.6.
- Appendix 11.7 – Predicted future concentrations of air quality emissions for impact scenario (ecological receptors) – Replaces the previously submitted Appendix 11.7.
- Appendix 11.8 – Predicted energy centre emissions concentrations – Replaces the previously submitted Appendix 11.8.
- Appendix 11.9 – Road traffic emission factors – This is a new appendix which did not form part of the submitted application.
- Appendix 12.4 – Traffic data used for noise modelling – Replaces the previously submitted Appendix 12.4.
- Appendix 12.5 – Ramboll noise survey for the Cavendish III Laboratories 2016 – This is a new appendix which did not form part of the submitted application.
- Appendix 12.6 – Max Fordham noise survey for the Civil Engineering Building 2016 – This is a new appendix which did not form part of the submitted application.
- Appendix 12.7 – Calibration certificates

Appendix 7.2 Full historic environment impact assessment

This appendix updates the built heritage parts of Appendix 7.2 which formed part of the submitted ES. Only the built heritage parts have been updated as the archaeology parts remain unchanged.

Table A7.2.1 Full historic environment impact assessment for the construction phase (built heritage only)

Baseline		**Impact assessment**				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Central Cambridge Conservation area and designated assets therein. The central conservation area covers the historic core of the city, open spaces including the college backs, Jesus Green, Midsummer Common and the Botanic Garden. The conservation area appraisal states that this 'interplay of grand college buildings and verdant landscape is perhaps the most enduring image of central Cambridge.' The central conservation area also includes some fine examples of 19th century domestic development, particularly surrounding the railway station.	High	Cambridge is located on flat, low lying land. This coupled with the tight urban grain ensures that there are relatively limited outward views from the majority of the central core, particularly at street level. Views from the principal open spaces within the urban core, such as the college quadrangles, the 'Backs' and Parker's Piece, for example, are similarly highly constrained, and will therefore not feature views of the construction. Some views westward from the upper levels or roof tops of certain buildings, such as from the St Johns and King's College Chapels, for example, may feature the tops of cranes and any other tall plant associated with the construction process in some views. However the majority of the construction process will be concealed by intervening buildings and vegetation, as well as the landform.	No mitigation is proposed	Minor	Medium distance views of construction plant and activities from some limited areas of the conservation area would have a temporary adverse effect on the setting of the conservation area	Slight **Not Significant**
Willow House (1331936). Grade II* listed. Two storey house built by George Checkley in 1932 with a later single storey extension. There are five tall symmetrically arranged windows on the first floor and window bands on the ground floor.	High	Willow house is located within densely landscaped grounds on Conduit Head Road, which is itself thickly planted with coniferous trees and shrubs. Outward views are highly constrained by this planting and the landscaping associated with Salix and the White House to the south. The construction will therefore not feature in the setting of the house.	No mitigation is proposed	Neutral	There will be no residual effect to the setting of Willow House	Neutral **Not Significant**
Shawms (1268363) Grade II* listed. Two storey house in the Modern Movement style with a single storey roof conservatory. The entrance has a projecting porch hood supported on two steel posts.	High	Shawms features extensive glazing to its south front, which faces over landscaped grounds to the Site. Views to the south are slightly filtered by mature planting and intervening buildings, however some visual intrusion, particularly from the presence of cranes and other tall plant, is likely.	No mitigation is proposed	Minor adverse	Glimpsed views of construction plant and activity will result in a temporary adverse effect to the setting of the building.	Slight Adverse **Not significant**
48 Storeys Way (1126090) Grade II* listed Two storey house built in 1913 by Ballie Scott. The building features an attic under a dramatic roofscape from which rise two tall chimney stacks with water tabling and narrow projecting caps.	High	Views in the direction of the Site are screened by the presence of Churchill College and the Moller Centre. The construction will not feature in the setting of the listed building.	No mitigation is proposed.	Neutral	There will be no residual effect to the setting of 48 Storeys Way	Neutral **Not Significant**

Baseline		**Impact assessment**				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
White House (1126037) Grade II listed. Two storey house with a third storey set back at the centre of the roof terrace built in 1930 by George Checkley in the International Modern style. The house has a rectangular plan with central entrance hall The facades are white painted brick and the roof is flat concrete.	Medium	The house is located within landscaped grounds adjacent to Madingley Road, immediately to the north of the Site. Views to the Site are somewhat filtered by dense boundary planting, however the presence of the plant and the construction process will constitute a change to the currently relatively tranquil setting of the asset.	No mitigation is proposed	Moderate adverse	Close views of construction plant and activity will result in a temporary adverse effect to the setting of the building.	Moderate Adverse **Significant Effect**
Salix (1227614) Grade II listed. 1 and 2 storey house built in 1934 and extended in1936 by George Checkley. Low long single storey wing of 5 windows and flat roof canopy on roof terrace. Original metal frame windows. The facades are white painted rendered brick and the roof is flat and bitumenised.	Medium	Salix is located within densely landscaped grounds on Conduit Head Road, which is itself thickly planted with coniferous trees and shrubs. Outward views are highly constrained by this planting and the landscaping associated with White House to the south. The construction will therefore not feature in the setting of the house.	No mitigation is proposed	Neutral	There will be no residual effect to the setting of Salix.	Neutral **Not Significant**
Spring House (1380900) Grade II listed The house was built in 1965-7 by Colin St John Wilson and his assistant M J Long. The construction is of pale cavity brick walls, with internal columns and partitions of timber and features a cut-away corner terrace and verandah above. The building has Concrete Roman tile monopitched roofs, with open timberwork beneath. L-shaped plan with corner angle cut away to form the terrace.	Medium	The house is located at the north end of Conduit Head Road. Views outwards are highly constrained by dense planting and intervening domestic development lining Conduit Head Road to the south. The construction will therefore not feature in the building's setting.	No mitigation is proposed	Neutral	There will be no residual effect to the setting of Spring House	Neutral **Not Significant**
The Observatory (1126156) Grade II listed Construction of the Observatory commenced in 1822.by the architect John Clement Mead. The building has two storeys, and is built from ashlar with slate and lead roofs in a Neo-Greek style. Built on a half H shaped plan with wings extending towards the North and projecting central tetrastyle portico of Doric Order to the south and front entrance. A small movable dome is located on the centre of the building.	Medium	The Observatory buildings are located at the end of an avenue of trees leading from Madingley Road, to the north of the Site. In addition to the avenue of trees the boundaries of the observatory compound are sparsely planted. There are relatively clear views to the south towards Madingley Road.	No mitigation is proposed	Minor adverse	Oblique, glimpsed views of the construction plant and activities will result in a temporary adverse effect to the setting of the Observatory.	Slight adverse **Not Significant**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Northumberland Dome at the Observatory (1126157) Grade II listed. The building was constructed around 1838 of white brick and a movable copper dome and is located in the grounds of the Observatory. The dome has since been reconstructed.	Medium	The construction phases, particularly the presence of tall plant such as cranes, hoardings and increased vehicle movement will feature in oblique views from the observatory group of assets, particularly in views down the entrance avenue. These will be somewhat filtered by intervening vegetation, particularly that to the boundaries of the Site and the observatory land.			Oblique, glimpsed views of the construction plant and activities will result in a temporary adverse effects to the setting of the copper Dome at the Observatory.	Slight adverse **Not significant**
Chapel, Churchill College (1331925) Grade II Listed. The college chapel was built in 1961-68 by Sheppard Robson and Partners. The building is constructed of brown brick, concrete, and has a copper roof. The building has a square plan with 'inscribed cross' and has simple, brick slab walls, separated by slit windows. The chapel was built against the wishes of the founding college fellows, particularly Francis Crick, hence its isolated position away from the main college buildings.	Medium	The chapel is located in an open expanse of lawn, and is somewhat removed from the rest of the college buildings, adjacent to the observatory complex. Elements of construction plant and activities may feature in some oblique views from the college. However these views will be substantially filtered by the presence of intervening boundary planting.	No mitigation is proposed	Negligible	There will be no residual effect to the setting of the chapel.	Neutral **Not Significant**
Research Flats, Churchill College (1331924) Grade II Listed. Two storey block of flats for researchers constructed in 1959-60 by Sheppard Robson and Partners. The buildings are constructed in a compact swastika layout from brown brick with flat roofs and have timber windows. Each flat has an outdoor terrace, secluded by storey-height walls, which continue to form the walls of the flats themselves.	Medium	Elements of construction plant and activities, particularly tall plant such as cranes, may feature in some oblique views from the building. However these views will be substantially filtered by the presence of intervening boundary planting and would not impact the building setting.	No mitigation is proposed	Negligible	There will be no residual effect to the setting of the flats.	Neutral **Not Significant**
Residential Courts at Churchill College (1227711) Grade II listed Two to three storey student residences constructed in 1961-68 by Sheppard, Robson and Partners. The building is constructed from brown brick and concrete and has varnished timber windows. The flat roofs are covered in copper. The facades are irregular with projecting brick bay windows at intervals,	Medium	The residential courts are located to the north of the Churchill college campus set in an open lawn with some scattered tree planting, and the other college buildings to the south and east. The landscape dips slightly to the north of the campus, which somewhat constrains outward views. Elements of the construction, particularly tall plant such as cranes, may feature in some oblique views from the residences. However these views will be substantially filtered by the presence of intervening boundary planting and landscaping and the gentle slope of the site and would not impact the building setting.	No mitigation is proposed	Negligible	There will be no residual effect to the setting of the residences.	Neutral **Not Significant**

Baseline		**Impact assessment**				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Wolfson Hall, Bracken Library and Bevin Rooms (1126008) Grade II listed. Two storey library with reading rooms and hall built in 1961-68 by Sheppard Robson and Partners. The building is constructed from brown brick and concrete. There is an external door of sculpted metal by Geoffrey Clarke.	Medium	The building is located within an irregular courtyard created by the southern residential courts (qv, 1126007) with no outward views to the surrounding landscape.	No Mitigation is proposed	Neutral	There will be no residual effect to the setting of the library.	Neutral **Not Significant**
Central Buildings Churchill College (1227706) Grade II listed. Two storey college building containing dining room and kitchens, common rooms, boiler house, college offices and main entrance built in 1961- 68 by Sheppard Robson and Partners. The building is constructed in an irregular 'H' plan from brown brick and concrete, both pre-cast and board-marked. The dining hall forms the link between the two parallel ranges.	Medium	The building is located to the north of the campus. Outward views are highly constrained by the campus buildings to the south (the residentially courts and the Wolfson Hall and Library, qv) there are limited outward views to the surrounding landscape.	No Mitigation is proposed	Neutral	There will be no residual effect to the setting of the college building.	Neutral **Not Significant**
Residential Courts at Churchill College (1126007) Grade II listed. Four linked residential courts of two to three storeys located due south-west of the Central Buildings of Churchill College GV II Student residences built in 1961-68 by Sheppard, Robson and Partners. The building is constructed from brown brick and concrete, and has varnished timber windows. The building has flat roofs covered in copper.		The residential courts are located to the south of the Churchill campus, immediately to the north of Madingley Road. The buildings are low lying and outward views in the direction of the Site are highly constrained by boundary landscaping and planting within the college campus. The campus site is bound by a high grassy bund and scattered tree planting, and the dense boundary planting within the Site. Tall plant, such as cranes, might be discernable above the tree line in some oblique views but this would not impact on the setting of the building.	No mitigation is proposed	Negligible	There will be no residual effect to the setting of the residential courts.	Neutral **Not Significant**
31 Madingley Road (1268371) Grade II listed. Early Modern Movement style house of two storeys rising to three storeys at the west end.	Medium	The house is set in densely landscaped grounds. Views to the Site are screened by the intervening development along Wilberforce Road and Bulstrode Gardens.	No Mitigation is proposed	Neutral	There will be no residual effect to the setting of the house.	Neutral **Not Significant**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
House and Brock Brothers Studio (1331872) Grade II listed. A house dating from the late 18th century with later 19th and 20th century additions, including a purpose-built artist's studio dating from 1908, designed by the Brock brothers for their own use. The principal elevation (north) is of three storeys and four bays. It has two flat-roofed polygonal bays to the ground and first floor with cornice detail, and contains twelve-pane vertical sash windows. The main entrance contains a late 18th century Roman Doric doorcase with fluted pilasters and pediment, and classical door with fielded panels and mouldings.	Medium	The house is located to the south of Madingley Road. Some filtered views to the Site may be possible from upper rear windows, however these will largely be constrained by intervening buildings and planting and would not impact the setting of the building.	No mitigation	Negligible	There will be no residual effect to the setting of the house.	Neutral **Not Significant**
9 Wilberforce Road (1268352) Grade II listed. Two storey Modern Movement house built in 1937 by D. Cosens. The building is constructed from whitewashed brick laid in Flemish bond with a bituminous felt roof. Rectangular plan with a recessed corner section at south-east corner.	Medium	The house is located opposite the Emmanuel College Sports Pitches, with the existing buildings on the Site visible beyond the trees lining Clerk Maxwell Road. The construction plant and activities will likely be visible from the listed building; however this will be partly screened by the intervening tree planting and the currently constructed elements of the existing masterplan.	No mitigation is proposed	Minor Adverse	Some medium range views of construction plant and activities would result in temporary adverse effects to the setting of the house.	Slight Adverse **Not Significant**
Emmanuel College Sports Pavilion, including grounds man's house and stables (1422595) Grade II listed. Sports pavilion with attached Groundsman's House and separate stable, built for Emmanuel College in 1910. Complex roofscape of steep, sweeping pitches and hipped roof surmounted by a decorative copper cupola which has a polygonal base and a weathervane.	Medium	The constructed elements of the masterplan are visible in views across the sports pitches, though they are somewhat screened by the presence of tree screening and intervening housing. The some construction activities and plant such as cranes will likely be visible from the listed building; however this will be partly screened by the intervening tree planting and the currently constructed elements of the existing masterplan.	No mitigation is proposed	Minor Adverse	Some medium range views of construction plant and activities would result in temporary adverse effects to the setting of the pavilion and house.	Slight Adverse **Not Significant**
Garden at 48 Storeys Way (1422759) Grade II Registered Park and Garden. Suburban Arts and Crafts garden laid out in 1913 to the designs of M. H. Baillie Scott. The garden forms a series of six outdoor 'apartments', as Baillie Scott called them, which change in character. They are laid out on a system of cross axes which provide vistas along the length and width of the garden.	Medium	Intervening buildings, particularly the Moller Centre and Churchill College, and the topography of the landform ensures that there are no views of the Site which could result in impacts to the setting of the garden.	No Mitigation is proposed	Neutral	There will be no residual effect to the setting of the garden.	Neutral **Not Significant**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Conduit Head Road Conservation Area The conservation area comprises 20th century residential development, built in a piecemeal fashion from approximately 1914. A number of modernist houses built in the 1930s and 1960s, are of particular note. These buildings provide a high quality and progressive architectural character to the area.	Medium	The conservation area boundary extends out into Madigley Road and includes two properties that face onto Madingley Road and the Site. Construction works and plant will be highly visible from the southern extent of the conservation area though it will be heavily screened by tree planting from the more northerly portion of the conservation area. This will be a substantial change to the currently relatively tranquil setting of the conservation area.	No mitigation is proposed	Moderate Adverse	Direct close views of construction activities and plant from the southern end of the conservation area will result in temporary adverse effects to the setting of the conservation area.	Moderate Adverse **Significant effect**
West Cambridge Conservation Area The conservation area is notable for its spacious residential streets lined with large mainly detached 19th and 20th century houses. A variety of college and university buildings are included in the conservation area. Despite the differences in the form, scale and materials between the residential and collegiate buildings the very high quality of nearly all the structures ensures that the area retains spatial cohesion. Green open spaces, including agricultural land and the college playing fields and tennis courts also contribute to the conservation area's significance.	Medium	The conservation area extends in an arc around the north east corner of the Site. The construction activities and plant will feature prominently in views to and from the west and north west of the conservation area, substantially eroding its relatively tranquil setting. The conservation area draws part of its significance from the interface between the suburban and rural at its western edge; the construction process will challenge this. However the construction will not be appreciable from many of the key areas within the conservation area, including Grange Road and the area surrounding the University Library, due to the presence of intervening buildings, mature tree planting and the low lying topography.	No Mitigation is proposed	Moderate Adverse	Direct close views of construction activities and plant from within the conservation area will result in temporary adverse effects to the setting of the conservation area.	Moderate Adverse **Significant Effect**
Storey's Way Conservation Area The special character of Storey's Way is derived from the fine detached family houses with their spacious gardens, interspersed with the collegiate grounds of Fitzwilliam and Churchill Colleges.	Medium	Some construction activities and plant may be visible from the upper read windows of some of the houses on the south side of the conservation area, these views are largely constrained by the Churchill college buildings, the adjacent Moller Centre and dense planting. The construction activities and plant will not be visible from Storey's Way in the central space of the conservation area.	No mitigation is proposed	Negligible	Some glimpsed views from limited locations within the conservation area would not result in significant effects to the setting of the conservation area.	Neutral **Not Significant**
Schlumberger Gould Research Centre Commercial research centre and office designed by Michael Hopkins and completed in 1985. The building is a tented structure suspended between a 'cat's cradle' arrangement of struts and supports. The building is both technically innovative, and a highly sculptural treatment for a late 20th century commercial building.	High	The significance of the Schlumberger Gould Research Centre lies in its position as an early and highly articulate example of a High-Tech building, by one of that style's leading British proponents. The technical innovation embodied in its design also contributes to the building's significance. Setting makes a limited contribution to the significance of the building. The construction will envelope the building on all sides, altering its currently relatively tranquil, semi-rural setting. This will hamper the appreciation of the building The architectural significance of the building will remain unaffected.	No mitigation is proposed	Minor Adverse	Construction activities will reduce the appreciation of the building by limiting existing views resulting in a temporary adverse effect.	Moderate adverse **Significant**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Merton Hall Farmhouse Two storey farmhouse built from gault brick with a slate roof and two end stacks. Three bay, central door to ground floor with a 20th century porch. Regular fenestration, windows all four pane sashs with flat arch brick	Low	The building would be demolished during construction. Demolition of the farmhouse has already been approved as part of the existing masterplan and extant planning permission and would occur irrespective of the Proposed Development.	No mitigation is proposed	No change	Demolition of the farmhouse has already been consented as part of the existing masterplan and extant planning permission and would occur irrespective of the Proposed Development.	Neutral **Not Significant**
Whittle Laboratory Academic building by Robert Mathew Johnson Marshall and Partners, completed in 1973. The building is constructed from brown brick with vertical strip windows	Negliigible	The building would be demolished	No mitigation is proposed	Major adverse	Demolition of the building during construction would result in the building's loss. This would be a permanent adverse effect.	Slight Adverse **Not Significant**
Cavendish Laboratory Complex of interconnected laboratories and other university buildings, largely two to three storeys, with horizontal windows. Completed in 1974 to designs by Robert Mathew Johnson Marshal and Partners utilsiing the CLASP method of prefabricated concrete panels.	Negliigible	The building would be demolished	No mitigation is proposed	Major adverse	Demolition of the building during construction would result in the building's loss. This would be a permanent adverse effect.	Slight Adverse **Not Significant**
Department of Veterinary Medicine. Complex of buildings by Ian Forbes, from 1953 onwards. Largely restrained neo-Georgian, with some neo-baroque details to the end pavilions. Intended to form part of a symmetrical run of buildings through the centre of the Site: as the only constructed elements of this, they appear stranded and unrelated to their context.	Negliigible	The building would be demolished	No mitigation is proposed	Major adverse	Demolition of the building during construction would result in the building's loss. This would be a permanent adverse effect.	Slight Adverse **Not Significant**

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Table A7.2.2 Full historic environment assessment for the operational phase

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Central Cambridge Conservation Area and designated assets within the Conservation Area boundary. The central Conservation Area covers the historic core of the city, open spaces including the college backs, Jesus Green, Midsummer Common and the Botanic Garden. The Conservation Area appraisal states that this 'interplay of grand college buildings and verdant landscape is perhaps the most enduring image of central Cambridge.' The central Conservation Area also includes some fine examples of 19th century domestic development, particularly surrounding the railway station.	High	The Proposed Development will be largely invisible from most the Conservation Area, which due to the nature of its topography and tight urban grain has constrained outward views. It will not feature in views from the Backs, for example, or from any of the college quads, which are highly significant open spaces within the Conservation Area. However, some taller elements of the Proposed Development, may be visible from limited elevated points within the Conservation Area, particularly from Castle Hill. In these views, it will appear as a distant element and very small element in views, which will be dominated by the architecture of central Cambridge, such as Kings College, Great St Mary's Church and the university library towers. The Tall Buildings Study identifies some key views of Cambridge from the south, particularly from the Gog MaGog hills. Any tall visible elements will form a very small element in the views compared with the architecture of central Cambridge. In relation to the significance of the Conservation Area as a whole, which is wide and multi-faceted, the setting impact would be negligible.	• At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45° angle to the parameter height of 31m AOD; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • Woodland infill planting at the site edges shall be native trees and shrubs and shall be in accordance with the Woodland Management Plan, Appendix 8.4, Volume 3; • Rooftop plant shall be set back from the predominant building line adjacent to Clerk Maxwell Road or effectively screened.	Negligible to Minor Adverse	Some glimpsed views of the few tall elements of the Proposed Development would be visible from limited elevated points within the Conservation Area, although they would be subordinate in views to nearer and prominent buildings in the centre of Cambridge. This would result in a permanent adverse effect.	Negligible to Slight Adverse **Not significant**
Willow House (1331936). Grade II* listed. Two storey house built by George Checkley in 1932 with a later single storey extension. There are five tall symmetrically arranged windows on the first floor and window bands on the ground floor.	High	Willow house is located within densely landscaped grounds on Conduit Head Road, which is itself thickly planted with coniferous trees and shrubs. Outward views are highly constrained by this planting and the landscaping associated with Salix and the White House to the south. The Proposed Development will therefore not be an appreciable element in the setting of the house.	No mitigation is proposed	Neutral	There will be no residual effect to the setting of Willow House	Neutral **Not Significant**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Shawms (1268363) Grade II* listed. Two storey house in the Modern Movement style with a single storey roof conservatory. The entrance has a projecting porch hood supported on two steel posts.	High	Shawms features extensive glazing to its south front, which faces over landscaped grounds to the Site. Views to the south are largely blocked by mature planting and intervening buildings. However, the Proposed Development will feature in restricted views to the south west, slightly altering the setting of the asset.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge. • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings; • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road.	Minor Adverse	Glimpsed views of the Proposed Development will result in a permanent adverse effect to the setting of the building.	Slight Adverse **Not significant**
48 Storeys Way (1126090) Grade II* listed Two storey house built in 1913 by Ballie Scott. The building features an attic under a dramatic roofscape from which rise two tall chimney stacks with water tabling and narrow projecting caps.	High	Views in the direction of the Site are screened by the presence of the Churchill College and the Moller Centre. The Proposed Development will not feature in the setting of the building.	No Mitigation is proposed	Neutral	There will be no residual effect to the setting of 48 Storeys Way	Neutral **Not Significant**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
White House (1126037) Grade II listed. See Section 4.3.	Medium	Views to the Site are largely screened by boundary planting, however the Proposed Development will feature in the setting of the asset, especially in views from the roadway in front of the building. The presence of large University buildings on the West Cambridge site currently forms part of the setting of the building, with a very light boundary tree screen on the south side of Madingley Road within the views along Conduit Head Road. With the denser proposed planting buffer on the Proposed Development site boundary on Madingley Road and the new buildings closer to the Madingley Road Boundary, the new buildings would be visible above the buffer screen, so the university buildings will be more imposing within the setting than currently.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge; • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings; • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road; • Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road.	Moderate Adverse	Closer views of the Proposed Development will result in a permanent adverse effect to the setting of the building, which will be partly offset by the thickened planting screen.	Moderate Adverse **Significant effect**
Salix (1227614) Grade II listed. 1 and 2 storey house built in 1934 and extended in1936 by George Checkley. Low long single storey wing of 5 windows and flat roof canopy on roof terrace. Original metal frame windows. The facades are white painted rendered brick and the roof is flat and bitumenised.	Medium	Salix is located within densely landscaped grounds on Conduit Head Road, which is itself thickly planted with coniferous trees and shrubs. Outward views are highly constrained by this planting and the landscaping associated with White House to the south. The Proposed Development will therefore not feature in the setting of the house.	No Mitigation is proposed	Neutral	There will be no residual effect to the setting of Salix.	Neutral **Not Significant**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Spring House (1380900) Grade II listed The house was built in 1965-7 by Colin St John Wilson and his assistant M J Long. The construction is of pale cavity brick walls, with internal columns and partitions of timber and features a cut-away corner terrace and verandah above. The building has Concrete Roman tile monopitched roofs, with open timberwork beneath. L-shaped plan with corner angle cut away to form the terrace.	Medium	The house is located at the north end of Conduit Head Road. Views outwards are highly constrained by dense planting and intervening domestic development lining Conduit Head Road to the south. The Proposed Development will therefore not feature in the building's setting.	No mitigation is proposed	Neutral	There will be no residual effect to the setting of Spring House	Neutral Not Significant
The Observatory (1126156) Grade II listed See Section 4.3.	Medium	The Observatory's two listed buildings are screened from view from the Proposed Development. The modern western fringe of the Observatory site has views of the Masterplan site and these contribute little to the buildings' significance. Restricted, narrow views along the access drive will largely be towards the thickened tree/planting screen in the north east corner of the site. The setting's contribution to the significance of the buildings will therefore be slightly affected	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge; • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings; • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road; • Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road.	Minor adverse	Views along the narrow access road will be slightly altered with a permanent adverse effect to the setting of the Northumberland Dome.	Slight adverse Not significant
Northumberland Dome at the Observatory (1126157) Grade II listed. See Section 4.3.	Medium				Negligible effect, as the building has no setting relationship with the development site.	Slight adverse Not significant

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Chapel, Churchill College (1331925) Grade II Listed. The college chapel was built in 1961-68 by Sheppard Robson and Partners. The building is constructed of brown brick, concrete, and has a copper roof. The building has a square plan with 'inscribed cross' and has simple, brick slab walls, separated by slit windows. The chapel was built against the wishes of the founding college fellows, particularly Francis Crick, hence its isolated position away from the main college buildings.	Medium	The chapel is located in an open expanse of lawn, and is somewhat removed from the rest of the college buildings, adjacent to the observatory complex. Elements of the Proposed Development, particularly rooftop structures and plant, may feature in some oblique views from the college. However these views will be substantially filtered by the presence of intervening boundary planting.	No mitigation is proposed	Negligible	There will be no residual effect to the setting of the chapel.	Neutral Not significant
Research Flats, Churchill College (1331924) Grade II Listed. Two storey block of flats for researchers constructed in 1959-60 by Sheppard Robson and Partners. The buildings are constructed in a compact swastika layout from brown brick with flat roofs and have timber windows. Each flat has an outdoor terrace, secluded by storey-height walls, which continue to form the walls of the flats themselves.	Medium	Elements of the completed scheme, particularly rooftop plant and chimneys, may feature in some oblique views from the college. However these views will be substantially filtered by the presence of intervening boundary planting.	No mitigation is proposed	Negligible	There will be no residual effect to the setting of the flats.	Negligible **Not significant**
Residential Courts at Churchill College (11227711) Grade II listed Two to three storey student residences constructed in 1961-68 by Sheppard, Robson and Partners. The building is constructed from brown brick and concrete and has varnished timber windows. The flat roofs are covered in copper. The facades are irregular with projecting brick bay windows at intervals,	Medium	The residential courts are located to the north of the Churchill college campus set in an open lawn with some scattered tree planting, and the other college buildings to the south and east. The landscape dips slightly to the north of the campus, which somewhat constrains outward views. Glimpsed views of the roofscape of the Proposed Development may be possible from some upper floors of the college building.	No mitigation is proposed	Negligible	There will be no residual effect to the setting of the residences.	Neutral **Not significant**
Wolfson Hall, Bracken Library and Bevin Rooms (1126008) Grade II listed. Two storey library with reading rooms and hall built in 1961-68 by Sheppard Robson and Partners. The building is constructed from brown brick and concrete. There is an external door of sculpted metal by Geoffrey Clarke.	Medium	The building is located within an irregular courtyard created by the southern residential courts (qv, 1126007) with no outward views to the surrounding landscape.	No Mitigation is proposed	Neutral	There will be no residual effect to the setting of the library.	Neutral **Not significant**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Central Buildings Churchill College (1227706) Grade II listed. Two storey college building containing dining room and kitchens, common rooms, boiler house, college offices and main entrance built in 1961- 68 by Sheppard Robson and Partners. The building is constructed in an irregular 'H' plan from brown brick and concrete, both pre-cast and board-marked. The dining hall forms the link between the two parallel ranges.	Medium	The building is located to the north of the campus. Outward views are highly constrained by the campus buildings to the south (the residentially courts and the Wolfson Hall and Library, qv) there are therefore limited outward views to the surrounding landscape.	No Mitigation is proposed	Neutral	There will be no residual effect to the setting of the college building.	Neutral **Not Significant**
Residential Courts at Churchill College (1126007) Grade II listed. Four linked residential courts of two to three storeys located due south-west of the Central Buildings of Churchill College GV II Student residences built in 1961-68 by Sheppard, Robson and Partners. The building is constructed from brown brick and concrete, and has varnished timber windows. The building has flat roofs covered in copper.	Medium	The residential courts are located to the south of the Churchill campus, immediately to the north of Madingley Road. The buildings are low lying, and outward views in the direction of the Site are highly constrained by boundary landscaping and planting to the college campus. The campus site is bound by a high grassy bund and scattered tree planting, and the dense boundary planting to the Site. Rooftop plant and the energy centre stack, might be discernable above the tree line in some oblique views but this would not impact on the setting of the building.	No mitigation is proposed	Negligible	There will be no residual effect to the setting of the residential courts.	Neutral **Not significant**
31 Madingley Road (1268371) Grade II listed. Early Modern Movement style house of two storeys rising to three storeys at the west end.	Medium	The house is set in densely landscaped grounds. Views to the Site are screened by the intervening development along Wilberforce Road and Bulstrode Gardens.	No Mitigation is proposed	Neutral	There will be no residual effect to the setting of the house.	Neutral **Not Significant**
House and Brock Brothers Studio (1331872) Grade II listed. A house dating from the late 18th century with later 19th and 20th century additions, including a purpose-built artist's studio dating from 1908, designed by the Brock brothers for their own use. The principal elevation (north) is of three storeys and four bays. It has two flat-roofed polygonal bays to the ground and first floor with cornice detail, and contains twelve-pane vertical sash windows. The main entrance contains a late 18th century Roman Doric doorcase with fluted pilasters and pediment, and classical door with fielded panels and mouldings.	Medium	The house is located to the south of Madingley Road. Some filtered views of the Proposed Development may be possible from upper rear windows, however these will largely be filtered by intervening buildings and planting and would not impact the setting of the building.	No mitigation	Negligible	There will be no residual effect to the setting of the house.	Neutral **Not significant**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
9 Wilberforce Road (1268352) Grade II listed. Two storey Modern Movement house built in 1937 by D. Cosens. The building is constructed from whitewashed brick laid in Flemish bond with a bituminous felt roof. Rectangular plan with a recessed corner section at south east corner.	Medium	The house is located opposite the Emmanuel College Sports Pitches, with the existing buildings on the Site visible beyond the trees lining Clerk Maxwell Road. As currently, the rooftops and taller elements of the Proposed Development will be visible, rising above the modern two storey housing in distant views to the west over the Emmanuel College sports pitches. However, the buildings will rise slightly higher than currently, slightly altering views from the asset.	• External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings; • At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45° angle to the parameter height of 31m AOD; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • Woodland infill planting at the site edges shall be native trees and shrubs and shall be in accordance with the Woodland Management Plan, Appendix 8.4, Volume 3; • Rooftop plant shall be set back from the predominant building line adjacent to Clerk Maxwell Road or effectively screened.	Minor Adverse	The University Buildings rising slightly higher above the two storey housing in views to the west than at present will result in permanent adverse effects to the setting of the house.	Slight Adverse **Not Significant**
Emmanuel College Sports Pavilion, including grounds man's house and stables (1422595) Grade II listed. Sports pavilion with attached Groundsman's House and separate stable, built for Emmanuel College in 1910. Complex roofscape of steep, sweeping pitches and hipped roof surmounted by a decorative copper cupola which has a polygonal base and a weathervane.	Medium	As currently, the rooftops and taller elements of the Proposed Development will be visible, rising above the modern two storey housing in distant views to the west over the Emmanuel College sports pitches. However, the buildings will rise slightly higher than currently, slightly altering views from the asset.	(as above)	Minor Adverse	The University Buildings rising slightly higher above the two storey housing in views to the west than at present will result in permanent adverse effects to the setting of the pavilion and house.	Slight Adverse **Not Significant**
Garden at 48 Storeys Way (1422759) Grade II Registered Park and Garden. Suburban Arts and Crafts garden laid out in 1913 to the designs of M. H. Baillie Scott. The garden forms a series of six outdoor 'apartments', as Baillie Scott called them, which change in character. They are laid out on a system of cross axes which provide vistas along the length and width of the garden.	Medium	Intervening buildings, particularly the Moller Centre and Churchill College, and the topography of the landform ensures that there are no views of the Site which could result in impacts to the setting of the garden.	No Mitigation is proposed	Neutral	There will be no residual effect to the setting of the garden.	Neutral **Not Significant**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Conduit Head Road Conservation Area See Section 4.3.	Medium	The presence of University buildings closer to Madingley Road than at present will impact on the views south along Conduit Head Road. However, the planting/tree screen along south side of Madingley Road will be thickened. In other respects, the screening to the south of the White House and the relative lack of sensitivity of the setting to the south and south west of the part of the Conservation Area to the east of the southern part of Conduit Head Road, means that the setting of the Conservation Area is quite robust. Also, the presence of university buildings on two sides of eth Conservation Area is part of its existing setting. There will therefore be a minor to moderate adverse change to the setting of the Conservation Area overall.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge. • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings. • Rooftop plant shall not be located within the 32m AOD zone along Madingley Road; • Any rooftop plant within the 37m or 41m AOD zones along Madingley Road shall be effectively screened in views from the north, to reduce any visual impact from Madingley Road.	Minor-Moderate Adverse	Close views of the Proposed buildings from the southern end of the Conservation Area will be partly offset by the thickened planting/tree screen, but would result in permanent adverse effects to the setting of the Conservation Area.	Minor to Moderate Adverse **Significant Effect**

Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
West Cambridge Conservation Area See Section 4.3.	Medium	The Proposed Development will not impact on significantly on the Conservation Area's setting in relation to the Observatory Site. The existing presence of the university buildings along the western part of the Masterplan Site in the setting of Churchill College will be accentuated, although there will be improved planting/tree screening. There will be little impact on the significance of the built up area on the west edge of the Conservation Area south of Madingley Road and north of Emmanuel College Sports Ground, due to the minor contribution of setting here and the intimate nature of this area. In relation to Emmanuel College Sports Ground and the stretch of Wilberforce Road from the north side of the sports ground to the junction with Adams Road, the new buildings will rise slightly higher behind the modern housing in the setting of the Conservation Area. This will have a minor to moderate impact locally. In relation to the Conservation Area as a whole, the West Cambridge site currently makes very little contribution the significance of the Conservation Area, and overall there will be a minor adverse impact, although in relation to Emmanuel College Sports Ground and a stretch of Wilberforce road this will be slightly elevated locally to moderate adverse. The presence of university buildings of good quality is a positive element of the character of the Conservation Area in the Conservation Area Appraisal.	• The maximum length of an uninterrupted building frontage and/or roof line shall not exceed 50m; • Any visible frontages facing onto Madingley Road, the eastern boundary, or the southern boundary (such as at site entrances), shall have a high quality architectural treatment. Generally, the woodland buffer shall be reinforced to limit visibility into the Site; • At the eastern edge of the Building Zone, adjacent to Clerk Maxwell Road, the built form shall comply with an additional height restriction of 25m AOD. From this line, the development heights shall remain within envelope rising by 45° angle to the parameter height of 31m AOD; • Colour choice of façade materials shall be carefully considered, as very light or reflective facade treatments can have greater impact on the surrounding landscape and views to the development; • Highly visible façades, located at sensitive edges and/or facing key spaces shall be treated using high quality materials and detailing; • Treatment of façades shall be sensitive in scale and the use of materials; • Any gaps or setbacks in development frontages along Madingley Road shall contain landscape planting and greenery to soften the development edge. • The buffer along the Madingley Road edge shall serve as a screening element for the Proposed Development. The buffer shall be supplemented where needed as set out in the Woodland Management Plan (Appendix 8.4, Volume 3); • Woodland infill planting at the site edges shall be native trees and shrubs and shall be in accordance with the Woodland Management Plan, Appendix 8.4, Volume 3; • External plant and/or storage structures (on frontage or separate structures) shall be minimised and shall not be visible from the West Cambridge and Conduit Head Road Conservation Areas, or associated listed buildings.	Minor adverse overall	The university buildings will appear bulkier in the setting of the Conservation Area resulting in permanent adverse effects on its setting.	Minor Adverse **Not Significant**
Storey's Way Conservation Area The special character of Storey's Way is derived from the fine detached family houses with their spacious gardens, interspersed with the collegiate grounds of Fitzwilliam and Churchill Colleges.	Medium	Some elements of the Proposed Development, particularly tall roof top plant and the energy centre stack, may be visible from the upper rear windows of some of the houses on the south side of the conservation area. These views are largely constrained by the Churchill college buildings, the adjacent Moller Centre and dense planting. The Proposed Development will not be visible from Storey's Way in the central space of the conservation area.	No mitigation is proposed	Negligible	Some glimpsed views from limited locations within the conservation area would not result in significant effects to the setting of the conservation area.	Neutral Not significant

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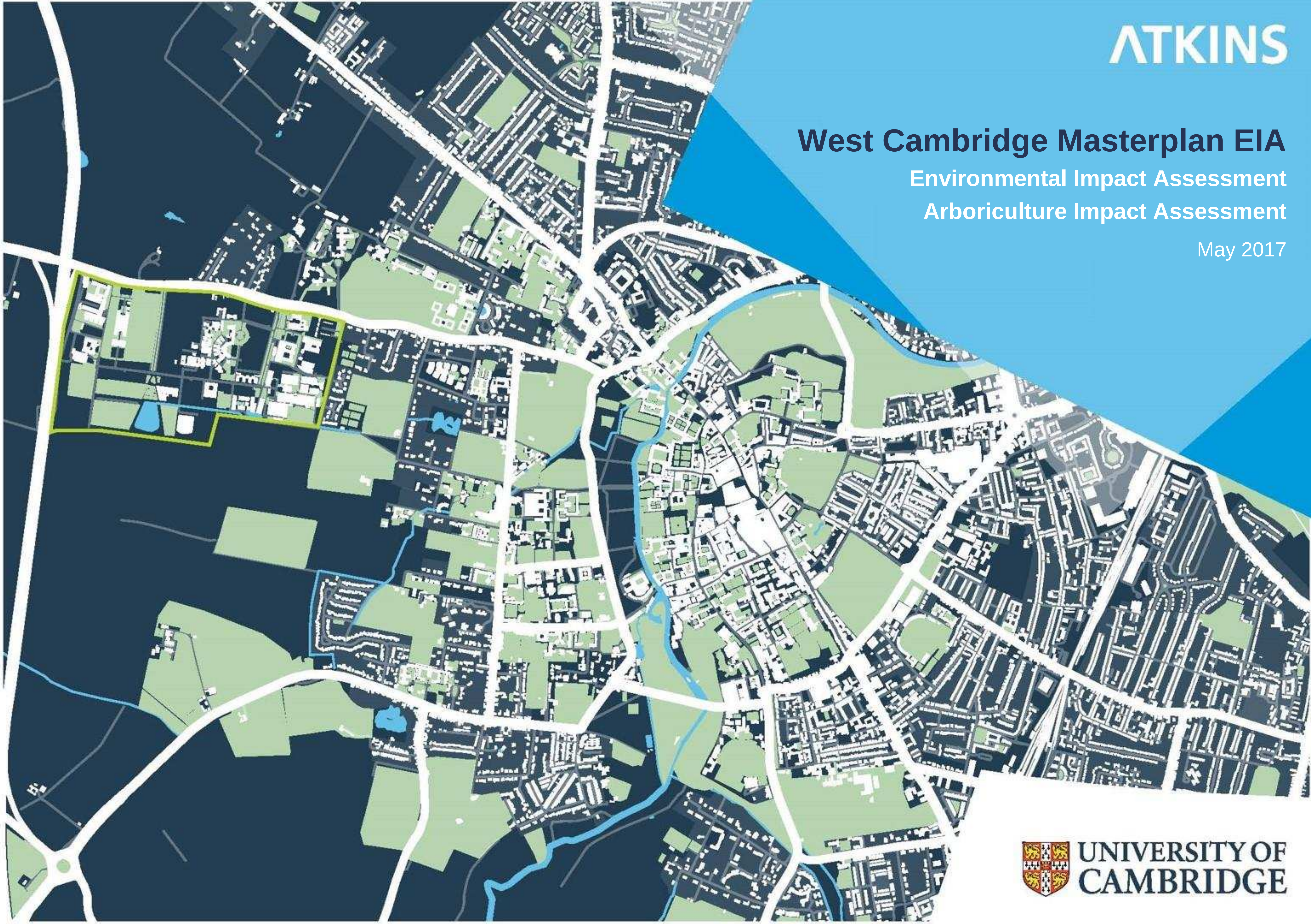
Baseline		Impact assessment				
Receptor	**Value**	**Impact**	**Mitigation measure**	**Impact magnitude**	**Residual effect**	**Significance of effect**
Schlumberger Gould Research Centre See Section 4.3.	High	The Proposed Development will result in filing the site to the east of the building, as intended by Hopkins. However, the blocks around will remain lower than the listed building and the linear open space within the masterplan means that there will remain views from the west from within the site. The architectural significances of the building will remain unaltered by the development in its setting. Although the setting will be substantially altered the contribution of the setting to the building's significance will be largely retained, as it was always meant to be part of a campus, and was intended to be a feature building, which it will remain.	• The Listed Schlumberger Research building shall remain the primary landmark for the site. New development and spaces shall work together to define a new and appropriate setting for this building; • A view corridor with a minimum 20m width will be preserved between JJ Thomson Avenue and High Cross to protect views through the Site of the Schlumberger Research Building; • On the west side of High Cross, the Listed Schlumberger Research building shall remain visible as a key site landmark; • In the central part of High Cross Avenue, a zone of lower development height shall be established to maintain the views of the Schlumberger Research building roof structure. The exact positioning of this lower zone shall be such to allow views of the roof-line (tent structure) from The Green.	Minor to moderate adverse	The setting will be altered but its contribution to the building's significance will largely be retained, as it was meant to be part of a campus.	Moderate adverse Significant Effect

Appendix 8.1 Arboriculture Impact Assessment



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West Cambridge Masterplan EIA

Environmental Impact Assessment

Arboriculture Impact Assessment

May 2017

UNIVERSITY OF CAMBRIDGE

Notice

This document and its contents have been prepared and are intended solely for the University of Cambridge's information and use in relation to the planning application for the West Cambridge Masterplan project.

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Document History

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Rev 1.0	Draft	TD	JH	DP	PW	25/02/15
Rev 2.0	Draft	TD	JH	DP	PW	17/05/16
Rev 3.0	Draft	TD	AA	DP	PW	10/02/17
Rev 4.0	Draft	TD	AA	DP	PW	26/04/17
Rev 5.0	Final	TD	AA	DP	PW	11/05/17

EIA Quality Mark

This Environmental Statement and the Environmental Impact Assessment (EIA) carried out to identify the significant environmental effects of the proposed development have been undertaken in line with our commitments as members of the EIA Quality Mark.

The EIA Quality Mark is a voluntary scheme operated by the Institute of Environmental Management and Assessment (IEMA) through our EIA activities are independently reviewed, on an annual basis, to ensure we continue to deliver excellence in the following areas:

EIA Management
EIA Team Capabilities
EIA Regulatory Compliance
EIA Context & Influence
EIA Content
EIA Presentation
Improving EIA practice

To find out more about the EIA Quality Mark and our registration to it please visit: www.iema.net/qmark

Contents

1. Introduction

1.1 Terms of reference

1.1.1 Atkins Limited (Atkins) has been commissioned by the University of Cambridge to undertake a tree survey in accordance with BS5837:2012 Trees in relation to design, demolition and construction – Recommendations, in support of an outline planning application (OPA) for the development of the West Cambridge site.

1.1.2 An existing masterplan for the site was approved in 1999 and reviewed in 2004 and currently forms the basis of the development on site. Accordingly, the academic and residential components have been delivered to the anticipated levels, but the commercial research and shared facilities components are below the envisaged 1999 masterplan. Policy 18 of the Draft Submission Local Plan supports the densification of the development through a revised masterplan subject to a number of conditions. It is within this context that the University of Cambridge is producing a new masterplan for the West Cambridge site which significantly increases the amount of development to approximately 423,000m^2.

1.1.3 The survey extents included all the trees within the West Cambridge Site as illustrated on the supplied topographical drawings produced by Greenhatch Group for Peter Brett Associates.

1.2 The application site

1.2.1 The West Cambridge site is located approximately 2km to the north-west of the centre of Cambridge in Cambridgeshire on the urban fringe of the city. The site is bound by Madingley Road to the north and by residential properties to the east. The M11 forms the western boundary to the site, beyond which lies agricultural land. Agricultural land bounds the site to the south.

1.2.2 The West Cambridge site is 66ha in area and comprises a mix of land uses including academic, commercial, sports, and residential. The site has undergone extensive development with completed buildings and areas under construction. These are supported by a network of roads and footpaths, car parks, formal landscaped public realm areas, and large paddocks associated with the veterinary school.

1.3 Proposed works

1.3.1 The masterplan approved in 1999 (planning application reference C/97/0961/OP) and reviewed in 2004 envisaged just under 250,000m^2 of development together with the pre-existing development on the site. The University of Cambridge is proposing densification of the development through a revised masterplan to increase the amount of development on site to approximately 423,000m^2. This is to be achieved through demolishing older existing buildings such as the Department of Veterinary Medicine Buildings and the Whittle Laboratory, and through developing areas of open space.

1.3.2 This impact assessment has been produced using the latest version (dated May 2017) of the produced parameter plans. These parameter plans have been overlaid onto the tree survey drawings to produce a set of tree protection plans.

1.4 Scope of works

1.4.1 This report presents Arboricultural information captured on 16th to 18th February 2015 by Atkins Senior Arboriculturist Tom Dale M.Arbor.A Cert Arb L6 (ABC), accompanied by Senior Landscape Architect Jonathan Hesketh on 17th to 18th February. Further site work was undertaken on 17th & 18th November 2016 by Atkins' Arboricultural Team Leader Tom Dale BSc (Hons), Cert Arb (L6 (ABC), M.Arbor.A, and Atkins' Landscape and Arboricultural Consultant Adam Atkins, BA (Hons) CMLI, TechCert (ArborA). This work being part of establishing data for the 'Woodland Management Plan'.

1.4.2 The scope of works includes the survey of trees within the site boundary and the production of an Arboricultural Impact Assessment with accompanying tree protection plans.

2. Methodology

2.1 General

2.1.1 This Arboricultural Impact Assessment has been undertaken in accordance with BS5837:2012 Trees in relation to design, demolition and construction – Recommendations. The standard gives recommendations and guidance on the relationship between trees and design, demolition and construction process, setting out the principles and procedures to be applied to achieve a harmonious and sustainable relationship between trees and structures.

2.2 Spatial Scope

2.2.1 The survey works spanned three days and concentrated on all the trees illustrated on the supplied topographical drawing produced by Greenhatch Group, drawing number 21144.

2.2.2 As identified in paragraph 1.4.1, further site work has been undertaken at the West Cambridge site for the purposes of establishing data for the site's 'Woodland Management Plan'. This involved capturing the locations of long lived 'canopy tree species' on the periphery of boundary tree groups.

2.3 Data Gathering

2.3.1 Data was collected in accordance with BS5837:2012, as outlined in Appendix A of this report. The purpose of the tree categorisation method applied by the Arboriculturist, being to identity the quality and value (in a non-fiscal sense) of the existing tree stock, allowing informed decisions to be made concerning which trees should be removed or retained if development is to occur.

2.3.2 For a tree to qualify under any given category, it should fall within the scope of that category's definition as defined in Figure A2 in Appendix A (category's U, A, B, C) and, for trees in categories A to C, it should qualify under one or more of the three subcategories (1, 2, 3). Subcategories 1, 2 and 3 are intended to reflect arboricultural and landscape qualities, and cultural values, respectively.

2.3.3 Trees were recorded as individual specimens and as groups. Where trees were recorded as groups measurements were taken from the largest tree within the group for the purposes of establishing data for the tree survey drawings. This level of survey meets the requirements of BS5837:2012, which states that *'trees growing as groups or woodland should be identified and assessed as such'*. The BS defines the term group as *'trees that form cohesive arboricultural features either aerodynamically (e.g. trees that* provide companion shelter), visually (e.g. avenues or screens) or culturally including for biodiversity (e.g. parkland or wood pasture).*'*

2.3.4 Crown spreads of the surveyed trees were given as an average measurement or to the relevant cardinal points with regards to the site. The average measurement was taken from the cardinal point relevant to the direction of the site or any proposals. This level of survey is deemed sufficient by the Arboriculturist in order to establish the extent of the crown spread in the direction of any future proposals. All crown spread measurements should be taken from the tree survey schedules

2.3.5 The trees were assessed in line with the Visual Tree Assessment (VTA) method as developed by Mattheck and Breloer (1994). This method is based on the axiom of uniform stress, whereby a tree will grow in response to environmental stimuli to produce a structure that bears forces evenly across its surface. As such an internal defect, such as decay, would initiate a noticeable change in the stem's shape to accommodate the physical change.

2.4 Survey

2.4.1 The locations of all the individual trees and the outlines of groups were taken from the supplied topographical data.

2.4.2 It is to be noted that trees were primarily recorded as groups based on their value being achieved through their collective landscape functions as avenues or screens, rather than trees of high arboricultural significance. Significant trees were also recorded as individual specimens. Significant trees in the context of this survey were trees of clearly identifiable cultural importance, mature specimens or dominant trees in groups.

2.4.3 The majority of trees onsite have been planted within the last ten years meaning they are still small in scale and replaceable. The survey primarily identified these trees as groups or identified significant trees within these groups where they require specific works.

2.4.4 The trees on site have been subjected to past surveys with numbered aluminium tags on the majority of trees. The ones missing likely to be a result of tree growth, as such the Arboriculturist has adopted their own number system commencing from 001 for individual trees and G001 for groups of trees. Where individual trees were recorded their tree tags were also captured in the tree survey schedules, where they were still attached. For tree groups the Arboriculturist recorded the tag number of the largest tree in the group where it was still attached.

2.4.5 The tree's captured as part of the 'Woodland Management Plan' survey have been tagged on the periphery of boundary tree groups. These trees have been captured as part of developing suitable offsets from any future proposed buildings to ensure they have sufficient space to achieve their full growth potential. The trees have been tagged from 1870-2000 and their locations plotted by an Atkins Land Survey Team, to ensure their accurate placement. In some cases the larger groups have been split into sub-groups as part of the 'Woodland Management Plan'. These sub-groups have not been recorded separately within this report as the species and other information relevant to a BS5837:2012 survey does not differ from the main group recording. It is to cover different management prescriptions as part of the 'Woodland Management Plan' and also to cover geographic location. The sub-groups relate to the following groups; W3(A&B), W4(A&C), G016(A-E) & G024(A)

2.5 Limitations to Survey

2.5.1 Trees were identified and inspected from ground level only and were not climbed. No invasive examination techniques (such as increment boring, or internal decay detection) were carried out and as such no assessment of the internal condition of the wood of these trees can be given. The tree survey undertaken is not intended to be a tree risk management survey targeting safety related issues. However, where specific hazards have been identified these have been recorded and management recommendations provided.

2.5.2 Where access permitted a Forest Ace Laser Hypsometer was used to measure tree heights and crown spreads of the tree stock.

2.5.3 BS5837: 2012 does not include arguments for or against development, or for the removal or retention of trees. Where development is to occur the standard provides guidance on how to decide which trees are appropriate for retention.

2.5.4 Validity, accuracy and findings of the tree locations will directly relate to the accuracy of information provided at the time of the survey, i.e. the supplied topographical drawing, and the accuracy of the plotted trees for the 'Woodland Management Plan'. Where tree groups have been illustrated as an outline this covers the extents of the tree group. It does not always illustrate individual trees within the groups. Where significant trees were identified in these groups they were plotted separately.

2.5.5 The report does not comment on possible effects of trees on neighbouring properties, including in relation to subsidence or heave, or with regard to possible hazards presented by trees surveyed. Neighbouring owners of trees that are identified as posing a possible risk to the property/site in question should seek their own advice as to possible effects of the recommendations given within this report.

2.5.6 Damage to, or possibility of damage to, any other structure that is not referred to within the report is not considered unless otherwise specified. This includes both neighbouring structures and any other structure on the property.

2.5.7 Trees are living organisms subject to changes outside human control. Trees and their environment alter with the seasons and it is as well to inspect trees whilst in full leaf and when out of leaf. Following harsh or unexpected weather conditions, or heavy storms it is also prudent to inspect trees. Changes to ground water conditions will affect the root growth of a tree. Such changes are not always the result of human influence and other factors may be involved.

3. Existing Site Conditions

3.1 Existing Land Use

3.1.1 The site is 66ha in area comprising a range of land uses including built infrastructure for academic, commercial and residential use divided by internal access roads, pedestrian routes and water features. There are expanses of open grassland located around the site as part of new informal and formal landscape features, as well as grazing pasture and areas of land left redundant for future development.

3.1.2 There are three main roads crossing the site in a north-south direction; JJ Thompson Avenue, High Cross Road and No Name Road. JJ Thompson Avenue and High Cross Site Road both provide access to the West Cambridge site from the A1303 Madingley Road.

3.2 Existing Tree Stock

3.2.1 The trees within the site are predominantly newly planted or young specimens planted within the past ten years as part of the developments undertaken on site. These form distinct avenues or formal lines of trees located in areas of public usage or denoting formal access routes. The repetition of species selection and planting structure is indicative of formal planting schemes with distinct lines or avenues being created. The species selection for these formal planting areas is typical for avenue features with Lime and London Plane being the species primarily used. The limited age of these trees reduces their arboricultural value at present. However, over time this will increase with their maturity.

3.2.2 The site also accommodates concentrations of newly planted or young trees within informal planting schemes located around wildlife features, (e.g. water features), and as part of reinforcing screening to views into the site from all cardinal points. These vegetative screens comprise woodland planting plots with trees and shrubs or groups of individual closely planted trees. The species selection is varied however Common Ash, Lime and English Oak dominate the climax tree species composition.

3.2.3 There are individual and groups of more mature trees located within the site, again forming distinct lines of trees or prominent standard specimens in formal and informal areas. The trees of note are the mature English Oaks forming remnants of old field boundaries in the north and south aspects of the site (tree refs 024, 037-039 & 063-068; the mature Silver Maples (tree refs 043 & G069) growing around the veterinary school; the prominent avenue of semi to early mature Lime trees (tree refs G57) leading to these facilities; the veteran Horse Chestnut within one of the north east car parks (tree ref 014); and the mature Willow specimens located sporadically around the pond area to the south of the site (tree refs 001, 013 & G37) . These trees are prominent specimens given their age, size and maturity. Their vitality and structural conditions were varied. However, the majority were in good vitality.

3.2.4 The northern and western boundaries sustain linear belts of more mature trees and shrubs that provide full or partial screening to views into the site from these locations. The tree stock again is varied in these locations including Ash and Sycamore. However, self-sown Elm trees are prevalent throughout. There are some more mature Elms that have been able to withstand Dutch Elm Disease to the east of JJ Thompson Avenue, but the majority are limited to young trees that have established from old tree stumps cut back in the past due to poor structural condition.

3.3 Site Topography

3.3.1 The site is set at grade with no significant level changes recorded throughout the site, except for localised planted earth mounds.

3.4 Soil Assessment

3.4.1 No soil assessment was carried out on site by the Arboriculturist although base line data from the British Geological Survey[1] states the site supports an area of mudstone bedrock with no superficial deposits recorded.

[1] http://www.bgs.ac.uk

4. Summary of Tree Condition

4.1 Number of Trees Recorded

4.1.1 The survey captured 76 no. individual trees, 110 no. groups and 4 no. woodlands on site as part of formal and informal groups located throughout the site.

4.2 General Condition Details

4.2.1 The survey sheets in Appendix B provide more detail on all the trees surveyed on site. In general the trees on site were showing signs of fair to good vitality with average bud formation and coverage for the tree species and locality. The trees varied in age structure with the majority being young trees.

4.2.2 The criteria for establishing tree BS Categories is detailed within the cascade chart in Appendix A of the report. This chart is taken from BS5837:2012.

4.2.3 In general BS Category A trees are high quality trees with an estimated 40+ years useful remaining life expectancy. These trees are often dominant trees in groups or ancient veteran specimens that offer high landscape amenity value or are of significant arboricultural or cultural value. The survey captured 13no. BS Category A trees as individual trees or groups.

4.2.4 In general BS Category B trees are those of moderate quality with an estimated 20+ year's useful remaining life expectancy. The trees are often downgraded due to remedial defects such as storm damage, over extended limbs, asymmetrical crowns or limited past management intervention. The survey captured 63no. BS Category B trees as individual trees or groups.

4.2.5 In general BS Category C trees are of low quality due to their young age or due to poor condition with an estimated 10+ year's useful remaining life expectancy. Whilst by definition such trees are of low quality as defined by their BS Category ratings they can still offer landscape amenity value as part of larger groups. The survey captured 108no. BS Category C trees as individual trees or groups. The majority of trees obtained a BS Category rating given their young age.

4.2.6 In general BS Category U trees are trees with serious structural defects or trees in poor physiological condition that reduces their remaining useful life expectancies below 10years. Where U trees have been recorded they may require remedial works to reduce the risk of harm to people or property that could be reasonably foreseen as coming into contact with the trees. These works should form part of tree risk management operations for the site. The survey captured 3no. BS Category U trees.

4.2.7 Preliminary management recommendations have been recorded for certain of trees surveyed on site. These works have been identified as part of managing the risk of failure or damage to people or property within proximity of the particular tree. These works should form part of the tree risk management strategy for the site and be undertaken independent of the proposals.

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5. Arboricultural Impacts

5.1 General

5.1.1 This survey takes into account the tree stock deemed likely to be affected by the proposed scheme and identifies their condition and suitability for retention. The tree protection plans drawing numbers 5137998/COL/ARB/01 TO 014 Rev D illustrate the extents of the survey area, the root protection area (RPA) for each tree or trees and the current parameter plans for developing the site.

5.1.2 The British Standard relies heavily on the creation of a protected zone referred to as the RPA around each tree. This is the minimum area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree's viability, and where the protection of the roots and soil structure is treated as a priority. This area should be protected from disturbance "in order to avoid unacceptable damage to the tree as a result of severance or asphyxiation of the root system." The recommended minimum area (m^2) for each tree to avoid potentially harmful disturbance has been calculated for all of the trees on site and entered into the tree schedule and is illustrated on the tree survey drawings.

5.1.3 The RPA(s) for each tree or group of trees is illustrated as a circle or an offset from the centre of the tree group or stem. This area does not take into account pre-existing site conditions or other factors that can influence or modify the shape and disposition of tree roots. Accordingly, the Arboriculturist can make modifications or judgements on the likely extents of RPAs, where through professional judgement it is deemed likely that the root zones have been restricted in a certain direction because of limiting factors such as; topography, drainage or the presence of existing built infrastructure.

5.2 Scheme details

5.2.1 The tree protection plans incorporate the current parameters plans showing the different building zones. However, these do not include any detailed designs, they merely cover the developable areas. As such this impact assessment, has been influenced by an agreed set of 'Design Guidelines' which cover those trees that are mandatory for retention, and those that could be removed to facilitate future development within the given areas, referenced as 'non-mandatory' trees to be retained within this assessment and on other submitted material.

5.2.2 All non-mandatory trees that fall within the building zones have currently been assigned either a red cross or red hatch on the tree protection plans. Their removal in the majority of cases is unavoidable. However, designers should use this impact assessment and accompanying tree protection plans to create detailed layouts that allow for the retention of some trees classed as non-mandatory for retention, especially mature trees or groups that offer high landscape amenity value. All non-mandatory trees to be retained that fall outside of the building zones have not been assigned a red cross, these are to be retained unless absolutely necessary.

5.2.3 Through consultation with the Local Authority specific offsets from any future buildings have been established from certain trees and groups in order to provide sufficient space for the trees to grow to their full potential without vertical and radial restriction. These have been entered into table 5.1 and also are illustrated on the TPPs where appropriate. It must be noted that these buffer zones vary depending on tree species, landscape function and likely future management. It ranges from 5m through to 15m. These zones often fall outside of the current RPAs of trees, however, this is due largely to the majority of the trees being relatively young in age and their existing constraints being limited as a result, i.e. crown spreads and stem diameters. These buffer zones are to inform any future proposals and in that regard they relate to buildings and subsequently development in the form of soft landscaping or lower level built infrastructure such as access roads or paths could be permitted in these zones.

5.2.4 As part of the 'Woodland Management Plan' for the site, legacy trees are to be established in specific boundary groups. The pertinent groups are referenced within Table 5.1. These legacy trees have not been selected at present, and relate to a specific number of chosen specimens within larger boundary groups that are to receive specific management to enable them to develop to large specimen trees. The exact trees are to be identified and recorded on site. Where these are recorded they are to receive a 15m buffer zone from any future proposed buildings in order to permit unrestricted radial spread of their crowns. Any future development will need to take this into account.

5.2.5 As no construction methodologies are known and detailed designs for each development zone are not included within the scope of this outline planning application the location of any specific mitigation measures to facilitate future proposals, including the location of protective barriers, ground protection and facilitation pruning, will have to be defined within either a scheme specific Arboricultural Impact Assessments or within an Arboricultural Method Statement (AMS) for the relevant development and there locations illustrated on updated TPPs, where required.

5.3 Arboricultural Impacts

5.3.1 The table below outlines the impacts of the proposals on the tree stock on site and likely mitigation measures required to facilitate the works.

Table 5.1 Tree stock and works

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
001(0626)	Crack Willow	C1	X	N/A	Tree located within a building zone, non-mandatory for retention. Tree of low quality as defined by BS Category.
G001(0625)	Limex4	C2	N/A	N/A	Trees located on edge of a building zone. Trees mandatory for retention as defined within the West Cambridge Design Guidelines.

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Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
G002	Elmx14, Sycamorex1, Hawthorn, Elder	B2	N/A	N/A	Trees outside of building zones. Tree group mandatory for retention as defined within the West Cambridge Design Guidelines.
G003	Elm, Elder, Hawthorn	C2	N/A	N/A	Trees outside of building zones. Tree group mandatory for retention as defined within the West Cambridge Design Guidelines.
G003A	Common Ash, Norway Maple, Sycamore,	B2	N/A	N/A	Trees outside of building zones. Tree group mandatory for retention as defined within the West Cambridge Design Guidelines.
G004(0571)	Lime	B2	N/A	N/A	Trees outside of building zones. Tree group mandatory for retention as defined within the West Cambridge Design Guidelines. 10m buffer zone to be adopted.
G005(0619)	Lime	B2	N/A	N/A	Trees outside of building zones. Tree group mandatory for retention as defined within the West Cambridge Design Guidelines. 10m buffer zone to be adopted.
G006(0629)	Common Ash	C2	X-11	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G007	Hazel, Blackthorn	C2	X-13	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G008(0866)	Common Ash	C2	X-13	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G009(0857)	Common Ash	C2	N/A	N/A	Trees outside of building zones. 10m buffer zone to be adopted.
002	Silver Birch	C1	N/A	N/A	Tree outside of building zones.
G010(0851)	English Oak "fastigata"	C2	X-5	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
003(0822)	Turkey Oak	B2	N/A	N/A	Tree outside of building zones.
004(0821)	Turkey Oak	B2	N/A	N/A	Tree outside of building zones.
005(0820)	Turkey Oak	B2	N/A	N/A	Tree outside of building zones.
G011(0702)	Common Alder	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G012(0694)	Cherry	B2	X-18	N/A	Trees located within a building zone. Trees of moderate quality as defined by BS Category.
G013	Liquid Amber x5	C2	X-5	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G014	Common Ash, Field Maple	B2	X-704m^2	N/A	Trees located within a building zone. Trees of moderate quality as defined by BS Category.
G015(1760)	Callery Pear	C2	X-50	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G016 G016A(1969-1985) G016B(1986-1992) G016C(1993-2000) G016D(1897-1900) G016E(1888-1896 G116(1965-1968)	Common Ash, Lime, English Oak, Cherry, Hazel	C2	N/A	N/A	Trees outside of building zones. Tree groups mandatory for retention as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
006	Leyland Cypress	B2	X	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.
007	Lombardy Poplar	C2	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G017	Field Maplex3	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.

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Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
G018 (008-011)	Common Ash, Norway Maple	B2	N/A	N/A	Trees outside of building zones. Tree group mandatory for retention as defined within the West Cambridge Design Guideline.
G019(1686)	English Oak, Beech, Lime, Horse Chestnut	B2, U	X-7	X-1	Trees outside of building zones. Fell 1691- horse chestnut in decline due to Bleeding canker and honey fungus on surface roots & on stems. 7no. south trees non-mandatory for retention. Remaining trees mandatory for retention as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
012(1704)	Common Ash	B1/2	X	N/A	Tree outside of building zones. Tree non-mandatory for retention as defined within the West Cambridge Design Guidelines.
G020(1703)	English Oak, Beech, Lime	C2	X-7	N/A	Trees outside of building zones. Trees non-mandatory for retention as defined within the West Cambridge Design Guidelines.
G021(1706)	English Oak, Chery, Horse Chestnut Beech, Lime	C2	N/A	N/A	Trees outside of building zones. Tree mandatory for retention as defined within the west Cambridge Design Guidelines.
013(1718)	Weeping Willow	B1/2	X	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.
014	Horse Chestnut	B3	X	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.
G022A	Grey Poplarx4	B2	N/A	N/A	Trees outside of building zones.
G022	Field Maple, Common Ash, Cherry, Hazel	C2	N/A	N/A	Trees outside of building zones.
015	Sycamore	B2	N/A	N/A	Tree outside of building zones.
016	Sycamore	B2	N/A	N/A	Tree outside of building zones.
017	Hawthorn	C2	N/A	N/A	Tree outside of building zones.

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
G023(0661)	Common Ash	C2	X-22	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G024 G024A(1887-1870)	Grey Poplar, Common Ash, Cherry, Silver Birch, Hawthorn, Lime, English Oak	B2	X-PART	N/A	Part of tree group located within a building zone. Trees of moderate quality as defined by BS Category. Majority of tree group mandatory for retention as defined within the West Cambridge Design Guideline. Sections non-mandatory as illustrated on the TPPs. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
G025(0719)	Lime	C2	X-13	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G026(0725)	Cherry	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
018(0728)	Himalayan birch	C2	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G027	Common Ash	C2	X-9	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
019(0807)	Horse Chestnut	C2	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G028	Flowering Cherry, Cockspur thorn	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G029	Himalayan birch	C2	X-16	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G030(0803)	Weeping Ashx3	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G031	Not Identified	C2	X	N/A	Tree located within a building zone.

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
G032(0796)	White beamx3	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
020(0800)	Whitebeam	B1	X	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.
G033(0784)	Whitebeam, Crab Apple	C2	N/A	N/A	Trees outside of building zones.
G034(0776)	Silver Birch	B2	N/A	N/A	Trees outside of building zones.
021	Flowering Cherry	B1/3	N/A	N/A	Tree outside of building zones.
G035(0760)	Alderx3	B2	N/A	N/A	Trees outside of building zones.
G036(0759)	Willow leaved Pearx4	B2	N/A	N/A	Trees outside of building zones.
G037(0756)	Weeping Willowx8	B2	N/A	N/A	Trees outside of building zones. Trees must be retained as defined within the West Cambridge Design Guidelines.
022(0753)	Field Maple	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G038(0740)	Horse Chestnut	B2	N/A	N/A	Trees outside of building zones. Trees mandatory for retention as defined within the West Cambridge Design Guidelines.
G039(0747)	Alderx3	C2	N/A	N/A	Trees outside of building zones. Trees mandatory for retention as defined within the West Cambridge Design Guidelines
023(0744)	White Willow	C2	N/A	N/A	Tree outside of building zones. Tree mandatory for retention as defined within the West Cambridge Design Guidelines
G040	Cherry, English Oak, Lime	C2	N/A	N/A	Trees outside of building zones. Trees mandatory for retention as defined within the West Cambridge Design Guidelines

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
G041	Field Maple, Elm, Alder, Hazel, Hawthorn,	C2	N/A	N/A	Trees outside of building zones. Trees mandatory for retention as defined within the West Cambridge Design Guidelines. 5m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
024(1562)	English Oak	A1/2/3	N/A	N/A	Tree outside of building zones. Trees mandatory for retention as defined within the West Cambridge Design Guidelines
G042	Weeping Willow	C2	N/A	N/A	Trees outside of building zones. Trees mandatory for retention as defined within the West Cambridge Design Guidelines
G043	Crack Willow	C3	N/A	N/A	Trees outside of building zones. Trees mandatory for retention as defined within the West Cambridge Design Guidelines
G044	Cherry	U	X	X-1	Trees within building zone. Fell west tree due to poor structural form.
G045	Crab Apple	C2	X-4	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
025(0787)	Silver Maple	B1	N/A	N/A	Tree outside of building zones.
G046(0789)	Silver Maple	C2	X-6	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G047(0895)	London Plane	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G048(1030)	Hornbeam	C2	X-90	N/A	Trees part located within a building zone. Trees of low quality as defined by BS Category.
G049(1565)	Golden Ash	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
026	Liquid Amber	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
027(1564)	Tulip Tree	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G050	Apple, Silver Birch, Willow	C2	X-29	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G051(1397)	Norway Maple	B2	X-3	N/A	3 no. trees located within a building zone. 1 no. tree mandatory for retention as defined within the West Cambridge Design Guidelines 10m offset to be adopted for any future buildings to provide sufficient space to grow to full potential. .
G052	Snowy mespilus, Pear	C2	N/A	N/A	Trees located within a building zone. Trees mandatory for retention as defined within the West Cambridge Design Guidelines Trees of low quality as defined by BS Category.
G053	Snowy mespilus, Pear	C2	N/A	N/A	Trees located within a building zone. Trees mandatory for retention as defined within the West Cambridge Design Guidelines Trees of low quality as defined by BS Category.
G054	London Plane	B2	N/A	N/A	Trees within a building zone. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
G055(1547)	Lime	B2	N/A	N/A	Trees outside of a building zone. Trees of moderate quality as defined by BS Category. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
G056(1541)	Lime	B2	X-7	N/A	7 no. trees located within a building zone. Trees of moderate quality as defined by BS Category. Remaining trees mandatory for retention as defined within the West Cambridge Design Guidelines
028(1493)	Norway Maple	B1*	N/A	N/A	Tree outside of building zones. Tree must be retained as defined within the West Cambridge Design Guidelines.
029(1532)	Apple	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
030(1530)	Lawson Cypress	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G057(1529)	Lime	A2	N/A	N/A	Trees outside of building zones. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
G058(1519)	Lime	C2	X-9	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
031(1854)	Luscomb Oak	A1	X	N/A	Tree located within a building zone. Tree of high quality as defined by BS Category.

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Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
032	Common Ash	B2	N/A	N/A	Tree on periphery of building zones. Tree mandatory for retention as defined within the West Cambridge Design Guidelines
033	Sycamore	B2	N/A	N/A	Tree on periphery of building zones. Tree mandatory for retention as defined within the West Cambridge Design Guidelines
034(1897)	Field Maple	B2	N/A	N/A	Tree on periphery of building zones. Tree mandatory for retention as defined within the West Cambridge Design Guidelines
035(1896)	Field Maple	B1	N/A	N/A	Tree on periphery of building zones. Tree mandatory for retention as defined within the West Cambridge Design Guidelines
036(1895)	English Oak	A1	N/A	N/A	Tree on periphery of building zones. Tree mandatory for retention as defined within the West Cambridge Design Guidelines
G059(1508)	Common Beech	A2	N/A	N/A	Trees outside of building zones. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
037	English Oak	A1	N/A	N/A	Tree outside of building zones. Tree must be retained as defined within the West Cambridge Design Guidelines.
038(1892)	English Oak	A1	N/A	N/A	Tree on periphery of building zones. Tree mandatory for retention as defined within the West Cambridge Design Guidelines
039(1891)	English Oak	A1	N/A	N/A	Tree on periphery of building zones. Tree mandatory for retention as defined within the West Cambridge Design Guidelines

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
G060	Cherry, Elder, Hazel, Sycamore, Lawson Cypress, Common Ash	C2	X-2	N/A	2 no. tree located within a building zone. Tree of low quality as defined by BS Category. Remaining trees mandatory for retention as defined within the West Cambridge Design Guidelines
040	Hybrid Black Poplar	C1/2	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
041(1494)	English Oak	B1/2	N/A	N/A	Tree located within a building zone. Mandatory tree to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space to grow to full potential.
042	Blue Atlantic Cedar	B2	X	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.
043(1497)	Silver Maple	B2	X	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.
044(1398)	Norway Maple	B2	X	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.
G061(1448)	Silver Birch	C2	X-19	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G062(1445)	Norway Maple	B2	X-2	N/A	Trees located within a building zone. Trees of moderate quality as defined by BS Category.
045(1440)	Cappadocian Maple	C2	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G063	Leyland cypress	C2	X-200m^2	N/A	Tree group located within a building zone. Trees of low quality as defined by BS Category.

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Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
046(1426)	Cappadocian Maple	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G064(1423)	Flowering Cherry	B2	N/A	N/A	Trees within a building zone. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for tree's to grow to their full potential.
047	Elder	C1	X	N/A	Tree within building zones.
048(1420)	Black Mulberry	B1	N/A	N/A	Tree outside of building zones. Mandatory tree to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
049(1419)	Flowering Cherry	B1	N/A	N/A	Tree outside of a building zone. Mandatory tree to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
G065(1470)	Cherry	C2	N/A	N/A	Trees outside of building zone. Trees of low quality as defined by BS Category.
G066(1461)	Silver Birch	B2	N/A	N/A	Trees outside of building zone. Mandatory trees to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
G067(1474)	Lime	B2	N/A	N/A	Trees outside of building zone. Mandatory trees to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
050(1475)	Sweet Gum	C1	N/A	N/A	Tree outside of building zones.
051(1476)	Norway Maple	C1	N/A	N/A	Tree outside of building zones.
G068(1456)	Norway Maple	B2	N/A	N/A	Trees outside of building zone. Mandatory trees to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
G069(1452)	Silver Maple	B2	N/A	N/A	Trees outside of building zone. Mandatory trees to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
G070(1450)	Crab Apple	B2	N/A	N/A	Trees outside of building zone. Mandatory trees to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
052(1449)	Crab Apple	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G071(1409)	Whitebeam	B2	N/A	N/A	Trees located within a building zone. Mandatory trees to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
053	Elder	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G072(1401)	Norway Maple	U, C2	X-6	N/A	Trees located within a building zone. Trees of low or poor quality as defined by BS Category.
054	Silver Birch	U	X	X	Tree located within a building zone. Tree also recommended for removal due to its poor condition.
G073(1392)	Hornbeam	C2	X	N/A	Part of group located within a building zone. Trees of moderate quality as defined by BS Category.
055(1477)	Hornbeam "fastigata'	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G074	Silver Birch	B2	X-2	N/A	Trees located within a building zone. Tree of moderate quality as defined by BS Category.
056	Sycamore	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G075	Elder, Silver Birch, Alder,	C2	X-10	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
057	Silver Birch	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
058(1490)	Silver Maple	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
059	Crab Apple	C1	X	N/A	Trees outside of building zone. Mandatory tree to be retained as defined within the West Cambridge Design Guidelines.
G076	London Plane	B2	N/A	N/A	Trees outside of building zones. Mandatory trees to be retained as defined within the West Cambridge Design Guidelines. 8m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
G077(1370)	Lime	B2	X-4	N/A	Trees located within a building zone. Trees of moderate quality as defined by BS Category.
060	Horse Chestnut	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
061	Field Maple	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G078	Field Maple, Black thorn	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G079	Hornbeam	C2	X-31	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G080	London Plane	C2	N/A	N/A	Trees outside of building zones.
G081	London Plane	C2	N/A	N/A	Trees outside of building zones. Mandatory trees to be retained as defined within the West Cambridge Design Guidelines. 8m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
G082	Hornbeam	C2	X-23	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
062(1084)	Apple	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G083	Sorbus spp	C2	X-12	N/A	Part of group located within a building zone. Trees of low quality as defined by BS Category.

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
G084	London Plane	C2	N/A	N/A	Trees outside of building zones. Mandatory trees to be retained as defined within the West Cambridge Design Guidelines. 8m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
G085	Hornbeam	C2	X-85	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G086	Various	C2	N/A	N/A	Trees outside of building zones.
W1 1937-1950	Ash, Field Maple, English Oak, Hawthorn, Hazel	C2	N/A	N/A	Trees outside of building zones. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential. 3 no. legacy trees to be identified and 15m offsets provide from any future buildings.
W2 1926-1936	Ash, Field Maple, English Oak, Hawthorn, Hazel	C2	N/A	N/A	Trees outside of building zones. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 5m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential. 3 no. legacy trees to be identified and 15m offsets provide from any future buildings.
063	English Oak	A1/2/3	N/A	N/A	Tree within a building zone. However, trees must be retained as defined within the West Cambridge Design Guidelines. 15m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
064	English Oak	A1/2/3	N/A	N/A	Tree within a building zone. However, trees must be retained as defined within the West Cambridge Design Guidelines. 15m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
065	English Oak	A1/2/3	N/A	N/A	Tree within a building zone. However, trees must be retained as defined within the West Cambridge Design Guidelines. 15m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
066(1839)	English Oak	A1/2/3	N/A	N/A	Tree within a building zone. However, trees must be retained as defined within the West Cambridge Design Guidelines. 15m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
067(1829)	English Oak	A1/2/3	N/A	N/A	Tree within a building zone. However, trees must be retained as defined within the West Cambridge Design Guidelines. 15m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
068(1826)	English Oak	B1/2/3	N/A	N/A	Tree within a building zone. However, trees must be retained as defined within the West Cambridge Design Guidelines. 15m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.
G087	English Oakx2	B1/2/3	N/A	N/A	Trees outside of building zones. Trees must be retained as defined within the West Cambridge Design Guidelines 15m offset to be adopted for any future buildings to provide sufficient space for tree to grow to full potential.

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
G088(1820)	Common Ash	C2	X-4	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
W3 W3A (1901-1913) W3B (1914-1925)	Field Maple, Common Ash, Elder, Blackthorn, English Oak, Scots Pine	B2	N/A	N/A	Trees outside of building zones. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential for plot 3A, 5m for 3B. 3 no. legacy trees to be identified and 15m offsets provide from any future buildings within plots 3A and 3B
W4 W4A(1951-1953) W4B(1954-1960) W4C(1961-1963)	Field Maple, Common Ash, Elder, Blackthorn, Sycamore	B2	N/A	N/A	Trees outside of building zones. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 5m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
G089	Beechx2	C2	X-2	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G090	Crab Apple, Hawthorn, Elder	C2	X	N/A	Part of group located within a building zone. Trees of low quality as defined by BS Category. Remaining group to be retained as defined within the West Cambridge Design Guidelines. 5m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
069	Common Ash	C1	N/A	N/A	Tree outside ofa building zone. Tree of low quality as defined by BS Category.
G091	Hornbeam, Hawthorn	C2	X-9	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
070(1579)	Service tree	B2/3	X	N/A	Tree located within a building zone.
G092(1170)	Sorbus sp	C2	X-4	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G093(1169)	Hornbeam 'fastigata'	B2	X-1	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.
071	Honey locust	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G094(1151)	Silver Birch x2	C2	X-2	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G095(1153)	Hornbeamx3, Silver Birchx1, Alder x3	C2	X-7	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
072(1156)	Alder	B1	X	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.
G096	Mixed	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G097(1185)	Mixed	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
073(1184)	Honey locust	C1	N/A	N/A	Tree outside of building zones.
G098(1181)	Weeping birchx6	C2	N/A	N/A	Trees outside of building zones.
074	Blue Atlantic Cedar	B1	X	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.

Group/ Tree No.	Species	Cat	Removal permitted		Details of how proposed build affects trees
			Dev	Cond	
G099(0216)	Scots Pine, Whitebeam Silver Birch, Cherry, Elder, Alder, Lawson's Cypress, Goat Willow, Field Maple,	C2	X-37	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
075	Alder	B1	X	N/A	Tree located within a building zone. Tree of moderate quality as defined by BS Category.
G100	Pearx4	C2	X-4	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
076	Lawson's cypress	C1	X	N/A	Tree located within a building zone. Tree of low quality as defined by BS Category.
G101(1234)	Silver Birch	B2	X-6	N/A	Trees located within a building zone. Trees of moderate quality as defined by BS Category.
G102(1250)	Norway Maple	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G103	Silver Birchx3	C2	X-4	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G104(1223)	Norway Maple x3, Scots Pine x1	C2	X-3	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G105	Silver Birch, Hawthorn Scots Pine, Lime, Whitebeam.	B2	N/A	N/A	Tree outside of building zones. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
G106(1341)	Horse chestnutx2, Limex1	C2	N/A	N/A	Tree outside of building zones.
G107(1346)	Cherry	B2	X-6	N/A	Trees located within a building zone. Trees of moderate quality as defined by BS Category. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
G108	Common Ash, Whitebeam	C2	X-34	N/A	Trees located within a building zone. Trees of low quality as defined by BS Category.
G109(1358)	Cherry, Lime	C2	N/A	N/A	Trees outside of building zones. Mandatory tree group to be retained as defined within the West Cambridge Design Guidelines. 10m offset to be adopted for any future buildings to provide sufficient space for long lived tree's to grow to their full potential.
G110	Various	C2	N/A	N/A	Trees outside of building zones.

5.3.2 The impacts of the building zones have been quantified as accurately as possible given the information available at this time. Where trees fall within the building zones and are not mandatory for retention they have been assigned a red cross or a red hatch for groups.

5.3.3 When assessing the tree removal it is clear that a considerable number of trees will have to be removed to facilitate the development of the site. However, this does not take into account the potential to retain trees within the different development plots. The designers should consider a sympathetic approach to the layout of any development to incorporate the retention of trees, especially those trees that have been assigned BS Categories of B and A as these are highly desirable for retention. In terms of tree removal justification for any proposals BS Category C trees should generally not hinder development given their low quality either as young trees or trees with limited useful remaining life expectancy. Certain trees have also been shown as 'must be retained' within the West Cambridge Design Guidelines, this details has been reflected in the table. The guidelines also identify trees that should be retained and the designers should use these guidelines to retain as many trees as possible.

5.3.4 This report and accompanying plans should be utilised by the designers to inform the layout of the detailed proposals to retain trees where appropriate. Once the finalised layout of the proposals has been determine the impacts on the trees will need to be quantified by an Arboriculturist. In order to provide details on the trees to be removed and any requirements for facilitation pruning and mitigation measures.

5.3.5 Designers may take into account that trees will tolerate a degree of root zone infringement depending on the works proposed and if they require any excavations, similarly, other factors to consider are species tolerance and the remaining un-surfaced RPA that can be retained. The BS5837 makes reference to 20% as a general rule in determining the amount of RPA infringement that could be achievable, but any such infringement into the RPA will have to follow consultation with and approval from the project arboriculturist. Where infringement of the RPA is considered acceptable at ground level further consideration will need to be given to any impact on the tree's canopy.

5.4 Preliminary Management Recommendations

5.4.1 Preliminary management recommendations have been recorded for some of the trees surveyed on site. These works have been identified as part of managing the risk of failure or to benefit the long term potential of the tree group to maximise their wildlife and screening potential.

5.5 Preliminary Mitigation Measures

5.5.1 At present no reference has been made to protective barriers. Once the designs in the different development plots has been finalised the location of mitigation measures shall have to be determined by an Arboriculturist. Protective barriers will be required to create construction exclusion zones (CEZ's) in order to protect the remaining RPA's of trees affected by the proposed works. The CEZ's will be defined as all the areas behind the fencing. Site operations not permitted in the CEZ without consultation with an Arboriculturist include storage of plant, equipment or materials, vehicular or plant access, washing down of vehicles or machinery, handling, discharge or spillage of any substances, including cement washings, actions likely to cause localised water-logging, no mechanical digging, scraping or excavation shall be permitted in the CEZ and no earthworks or changes in the finished ground levels other than those agreed by an Arboriculturist.

5.5.2 The locations of protective barriers will have to be determined at detailed design phase and once construction methodologies are readily known and should be detailed within an Arboricultural Method Statement (AMS). The protective barriers will need to be installed prior to any works commencing. The barriers are to be erected to exclude construction activity in the RPAs of retained trees and are to conform to figure 3b of BS5837:2012 (page 21), a heras type fencing.

5.5.3 The AMS would also identity any further mitigation measures to protect retained trees including the provision of ground protection or hand excavations to reduce the potential of damaging tree root zones.

6. Arboricultural Method Statement

6.1 Heads of Terms

6.1.1 A site specific Arboricultural Method Statement (AMS) will address some or all of the following:

- Removal of existing structures and hard surfacing;
- Installation of temporary ground protection;
- Excavations;
- Installation of new hard surfacing – materials, design constraints and implications for levels;
- Tree works schedule;
- Tree protective barriers;
- A schedule of specific events requiring input or arboricultural supervision.

Appendix A. Key & BS5837:2012 survey table

Tree No: Sequential reference number given to the tree or group of trees as shown on the tree survey drawings.

Species: This is the common name given to the tree. The botanical name is sometimes given.

Height (Ht): tree height from the base of the tree to its heights stem, measured in metres (m). Measurements are taken to the nearest half metre.

Stem diameter (mm): measured in accordance with figure A1 below. Measurements rounded to the nearest 10mm.

Branch spread (m): measurement of crown spread to the four cardinal points, if the crown is balanced a single measurement is given. Crown spread plotted on the tree survey drawings. Measurements are taken to the nearest half metre.

1st significant branch and direction of growth (m): measurement of the height of the first significant branch above ground level, given in metres and direction of growth e.g. 2.4-N

Canopy height (m): height of the canopy above ground level. Measurements are taken to the nearest half metre.

Life stage: The following abbreviations are used:

Y = Young trees <1/5 life expectancy.

SM = Semi-Mature trees 1/5 – 2/5 life expectancy.

EM = Early Mature trees 2/5 – 3/5 life expectancy.

M = Mature trees 3/5 – 4/5 life expectancy

OM= Over-Mature trees >4/5 life expectancy

General observations, particularly of structural and/or physiological condition: e.g. observations of the any decay and physical defect.

Preliminary management recommendations: any identified preliminary management to rectify defects recorded in general observations. These may include the need for further detailed inspection, or works to address immediate hazard to life or property.

Estimated remaining contribution, in years:

<10

10+

20+

40+

Category grading: As per BS5837:2012 chart in accordance with figure A2 below.

A – Illustrated as light green (RGB code 000-255-000)

B – Illustrated as Mid blue (RGB code 000-000-255)

C – Illustrated as Grey (RGB code 091-091-091)

U – Illustrated as Dark red (RGB code 127-000-000)

Root Protection Area (m^2): plotted around each of the category A, B and C trees on relevant drawings, and illustrates the minimum area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree's viability , and where the protection of the roots and soil structure is treated as paramount.

(Note: Red hash tag '#' will denote that a measurement is estimated)

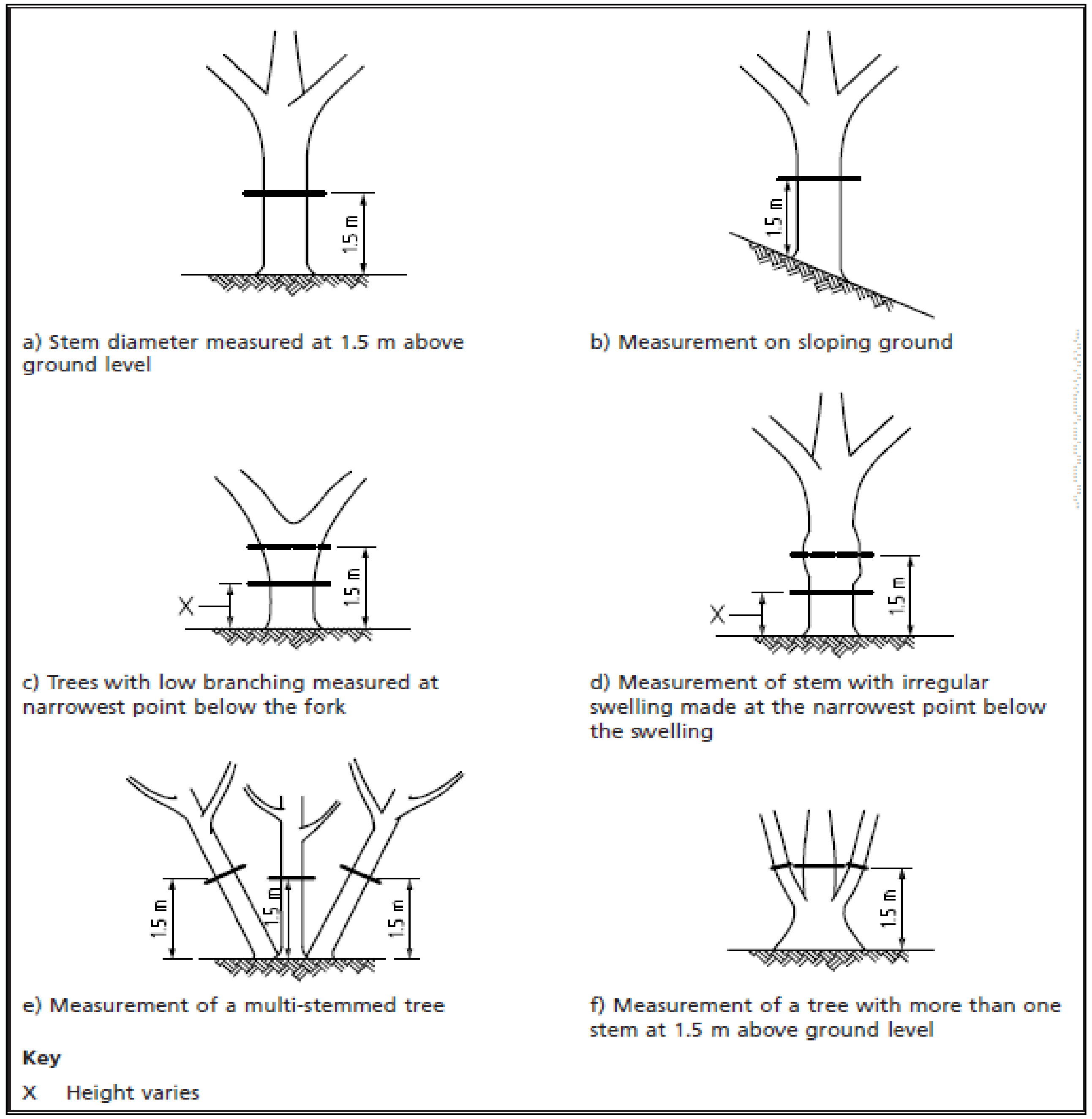

Figure A.1 Measurement of tree stems dependant on tree form

Table A.1 Cascade chart for tree quality assessment from BS5837:2012

Category and definition	Criteria (including subcategories where appropriate)		
Trees unsuitable for retention (see Note)			
Category U Those in such a condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years	• Trees that have a serious, irremediable, structural defect, such that their early loss is expected due to collapse, including those that will become unviable after removal of other category U trees (e.g. where, for whatever reason, the loss of companion shelter cannot be mitigated by pruning) • Trees that are dead or are showing signs of significant, immediate, and irreversible overall decline • Trees infected with pathogens of significance to the health and/or safety of other trees nearby, or very low quality trees suppressing adjacent trees of better quality *NOTE Category U trees can have existing or potential conservation value which it might be desirable to preserve; see* **4.5.7**.		
	1 Mainly arboricultural qualities	**2 Mainly landscape qualities**	**3 Mainly cultural values, including conservation**
Trees to be considered for retention			
Category A **Trees of high quality** with an estimated remaining life expectancy of at least 40 years	Trees that are particularly good examples of their species, especially if rare or unusual; or those that are essential components of groups or formal or semi-formal arboricultural features (e.g. the dominant and/or principal trees within an avenue)	Trees, groups or woodlands of particular visual importance as arboricultural and/or landscape features	Trees, groups or woodlands of significant conservation, historical, commemorative or other value (e.g. veteran trees or wood-pasture)
Category B **Trees of moderate quality** with an estimated remaining life expectancy of at least 20 years	Trees that might be included in category A, but are downgraded because of impaired condition (e.g. presence of significant though remediable defects, including unsympathetic past management and storm damage), such that they are unlikely to be suitable for retention for beyond 40 years; or trees lacking the special quality necessary to merit the category A designation	Trees present in numbers, usually growing as groups or woodlands, such that they attract a higher collective rating than they might as individuals; or trees occurring as collectives but situated so as to make little visual contribution to the wider locality	Trees with material conservation or other cultural value
Category C **Trees of low quality** with an estimated remaining life expectancy of at least 10 years, or young trees with a stem diameter below 150 mm	Unremarkable trees of very limited merit or such impaired condition that they do not qualify in higher categories	Trees present in groups or woodlands, but without this conferring on them significantly greater collective landscape value; and/or trees offering low or only temporary/transient landscape benefits	Trees with no material conservation or other cultural value

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Appendix B. Tree survey schedules

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM/EM/M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20+/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
001(0626)	Crack Willow	10	1250	6	3-SW	1.8	OM	Fair vitality. Crown topped at 7m. Rapid regenerated stems at pruning wounds. Onset of decay visible at pruning points with deadwood and Un-occluded wounds.	Manage as reduced tree	10+	C1	15.0
G001(0625)	Limex4	To 7	220	To 3.5	n/a	1.8	Y	Line of 4 trees. Good vitality throughout. Some tight forks in canopies. Not significant at present. No apparent significant structural defects recorded	No works presently required	40+	C2	2.6
G002	Elmx14, Sycamorex1, Hawthorn, Elder	To 20	250-700	To S-8	n/a	GL	Y-M	Small informal group. Occasional elder & hawthorn. Predominantly elm. Ivy clad stems, including dead ivy. Mutual crown suppression. Drawn forms on younger trees. Some failed stems at ground level. Small diameter deadwood in crowns. No visible signs of Dutch elm disease. Fair to good vitality throughout.	Sever regenerated ivy.	20+	B2	8.4
G003	Elm, Elder, Hawthorn	To 6	To 250	To N-4	n/a	GL	Y-EM	Informal linear group of predominantly self-sown elm, forming old field boundary hedgerow in places. Stumps of dead elms in sporadically located throughout group. Dead elm management evident with felled stems. Remaining live tree previously cut to 1m. Hawthorn & elder within group as well. Heavy ivy encroachment on stems, suppression of crowns - small diameter deadwood present. Fair vitality.	Sever ivy on stems, fell dead elms. Cut back over extended branches towards footpath.	10+	C2	3.0
G003A	Common Ash, Norway Maple, Sycamore,	To 16	To 300x2	To S-8	n/a	GL	SM-EM	Part of boundary vegetation. Intermittent trees. Single & multi stem forms suggesting past coppice management or self-sown. Heavy ivy encroachment on stems & dead ivy in places where it has been severed. Fair vitality throughout, deadwood in crowns and sections of dieback from ivy shading and competition for light. Leans and drawn stems	Sever ivy, remove deadwood overhanging footpath	20+	B2	5.1
G004(0571)	Lime	To 7	To 290	To 4	n/a	1.8	Y	Linear planting forming an avenue. Pruning wounds in crowns from crown lifting. Good vitality throughout. Some tight forks in crowns, synonymous of species and not significant at present.	No works presently required	40+	B2	3.5

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G005(0619)	Lime	To 7	To 230	To 4	n/a	1.8	Y	Linear planting forming an avenue. Pruning wounds in crowns from crown lifting. Mistletoe in crown tree-0599, not significant. Good vitality throughout. Some tight forks in crowns, synonymous of species and not significant at present.	No works presently required	40+	B2	2.8
G006(0629)	Common Ash	To 7	To 190	To 3.5	n/a	1.8	Y	Linear planting forming an avenue feature. Good vitality throughout. No signs of ash dieback. Rabbit wire on main stems of northern line. Potential to restrict main stem growth. No apparent significant structural defects recorded	Remove or loosen rabbit wire	20+	C2	2.3
G007	Hazel, Blackthorn	To 4	To 100	To 2	n/a	GL	Y	Linear plot of shrubs. Good vitality. Screening function. No apparent significant structural defects recorded	No works presently required	20+	C2	1.2
G008(0866)	Common Ash	To 7	To 110	To 2	n/a	1.8	Y	Line of trees set within a beech hedgerow. Good vitality. No apparent significant structural defects recorded	Remove ivy from stems	20+	C2	1.3
G009(0857)	Common Ash	To 8	To 180	To 3	n/a	1.8	Y	Line of trees growing in grassed surface. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	20+	C2	2.2
002	Silver Birch	5	110	2	0.8-E	0.2	Y	Single tree. Good vitality. Crown will obstruct camera over time. Ivy at base	No works presently required	20+	C1	1.3
G010(0851)	English Oak "fastigata"	To 8	To 170	To 1.5	n/a	0.1	Y	Linear planting forming an avenue. Fastigate form. Good vitality throughout. Southern line within building site, bases not inspected.	No works presently required	20+	C2	2.0
003(0822)	Turkey Oak	12	420	S-6.5, 6	2-S	2	SM	Growing on top of slopped grass bank. Good vitality. Crown break at 1.9m. Merged limbs in southern crown extents. Not significant at present. Bird or mammal nest in upper canopy.	No works presently required	40+	B2	5.0
004(0821)	Turkey Oak	12	380	6, E-4	2-S	1	SM	Growing on top of slopped grass bank. Single stem to 8m, co-dominant stems from 8m. Fair to good vitality, small diameter deadwood in crown - considered to be due to competition for light.	No works presently required	40+	B2	4.6
005(0820)	Turkey Oak	12	340	W-2, 6	2-S	1.4	SM	Growing on top of slopped grass bank. Good vitality. Crown break at 2m. Single stem to 5m. No apparent significant structural defects recorded	No works presently required	40+	B2	4.1

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM/EM/M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20+/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G011(0702)	Common Alder	To 10	To 175	N-4, S-3, E&W-3	n/a	1.8	Y	Line of 3xtrees. Planting pits covered by metal tree grilles. Good vitality. No surface root activity recorded.	No works presently required	40+	C2	2.1
G012(0694)	Cherry	To 8	To 230	To 5.5	n/a	1.8	SM	Formal group planting. Mix of planting environments including pea gravel and part of planted plots with shrubs. Good vitality throughout. Occasional sap bleeds at old branch wounds, not significant at present.	No works presently required	40+	B2	2.8
G013	Liquid Amber x5	To 6.5	To 130	To 2	n/a	1.6	Y	Formal planting. Planting pits covered in decorative gravel. Fair vitality throughout, sparse crowns in places, loss of apical dominance on central southern tree.	No works presently required	20+	C2	1.6
G014	Common Ash, Field Maple	To 10	To 220	To 4	n/a	GL	Y-SM	Linear plot of trees & shrubs. Good vitality throughout. Drawn stems on Field Maples. No apparent significant structural defects recorded. Landscape merit	No works presently required	40+	B2	2.6
G015(1760)	Callery Pear'	To 4.5	To 120	To 2	n/a	1.8	Y	Formal planting set in hard surfaces. Tree pits protect by metal grilles. Surface roots displacing grilles in places. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	40+	C2	1.4
G016 G116	Common Ash, Lime, English Oak, Cherry, Hazel	To 10	To 200	To 2.5	n/a	GL	Y	Boundary screen planted plots, mix of trees & shrubs. Good vitality throughout, small diameter deadwood in crowns from competition for light. No apparent significant structural defects recorded.	Selective thinning to promote establishment of English Oak	40+	C2	2.4
006	Leyland Cypress	22	1000	To 4.5	n/a	0.2	EM	Prominent boundary tree. Good vitality. Pronounced buttress roots. No evidence of root plate movement. Dense crown. Structural defects potentially obscured.	No works presently required	20+	B2	12.0
007	Lombardy Poplar	14	300x2	4	0.5-S	GL	SM	Boundary tree. Co-dominant stems at 0.3m. Good vitality. Surface roots displacing block paving to south east.	No works presently required	10+	C2	5.1
G017	Field Maplex3	To 7	To 200	To 3.5	n/a	GL	Y	Trees growing on top of slopped grass bank. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	40+	C2	2.4

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G018 (008-011)	Common Ash, Norway Maple	To 16	011-300x2, 500	To S-9.5	n/a	3-S	SM-M	Part of boundary vegetation. Fair to good vitality throughout. 008-Common Ash, co-dominant stems at 3m, union not visible. Ivy encroachment on stems to 8m. 009-Norway Maple, co-dominant stems at 0.5m, tight union with included bark junction. Not significant at present. Ivy encroachment on stems. 010-Sycamore, co dominant stems at 2m, not visible. Ivy encroachment on stems. 011-Common Ash, 3xstems from 1m. Open crown. dead ivy in canopy	Sever ivy throughout group to facilitate ongoing condition related inspections	20+	B2	6.0
G019(1686)	English Oak, Beech, Lime, Horse Chestnut	To 7	To 290	To 3.5	n/a	1.8	Y	Informal planted plot, grass at bases. Good vitality throughout. No apparent significant structural defects recorded	Fell 1691- horse chestnut in decline due to Bleeding canker and honey fungus on surface roots & on stems.	40+	B2, 1691-U	3.5
012(1704)	Common Ash	16	540, 500	9	2-W	2	M	Boundary tree. Growing in grassed sunken area. Co dominant stems at 1m, union not included. Stems split into further co dominant unions at 2m. East stem included bark junction at split, abrupt angles on limbs beyond 3m. Suggests past crown reductions. Not significant at present.	No works presently required	20+	B1/2	8.8
G020(1703)	English Oak, Beech, Lime	To 7	To 250	To 3.5	n/a	2	Y	Informal planted plot growing on top of slopped grass bank. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	40+	C2	3.0
G021(1706)	English Oak, Chery, Horse Chestnut Beech, Lime	To 8	To 250	To 3.5	n/a	2	Y-SM	Informal planted plot growing on top of slopped grass bank. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	40+	C2	3.0
013(1718)	Weeping Willow	14	900	6	1.8-N	2	M	Growing on boundary in sunken grass area. Old pollard. Cavities and areas of decay visible at old pruning wounds. Rapid regenerated stems at points. Main stem multi stem form at 2m. Ground lights installed in root zone	Maintain as reduced tree.	40+	B1/2	10.8
014	Horse Chestnut	6	1250	3	n/a	1	OM	Bespoke engineered solution around root zone to mitigate for change in ground levels. Metal grid system. Tree topped at 6m. Epicormic growth on main stem & branches-limited. Crown break at 3m into 6xstems. Veteran tree.	No works presently required	10+	B3	15.0

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Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G022A	Grey Poplarx4	To 18	To 550	To W-10	n/a	3	EM	Line of 4 trees. Growing on east boundary adjacent to footpath. Good vitality throughout. Leans on trees, southern tree on 30degree lean-no root plate movement recorded. Surface roots displacing asphalt footpath to west.	No works presently required	20+	B2	6.6
G022	Field Maple, Common Ash, Cherry, Hazel	To 10	To 200	To W-4	n/a	GL	Y-SM	Linear belt of trees & shrubs. Drawn stems throughout. Fair vitality given competition for light & ivy encroachment on stems shading canopies.	Selective coppice	20+	C2	2.4
015	Sycamore	15	500@200	W-7	1-W	2	EM	Growing adjacent to footpath. Tree splits into 4xstems at 1m. Unions appear sound. Small diameter deadwood in crown. Fair vitality.	Remove deadwood overhanging footpath	20+	B2	6.0
016	Sycamore	15	350, 370	W-5	3-N	3	EM	Growing adjacent to footpath. 2xstems from ground level. Slight lean on stems to north. Fair vitality with small diameter deadwood in crown.	Remove deadwood overhanging footpath	20+	B2	6.1
017	Hawthorn	5	300@200	W-4	0.5-W	2	EM	Growing adjacent to footpath. Multi stem form at 0.5m. Crown suppressed to north. Fair vitality with small diameter deadwood in crown.	No works presently required	20+	C2	3.6
G023(0661)	Common Ash	To 7	To 200	To 3	n/a	1.8	Y	Formal planting. Trees in car park. Good vitality throughout, no apparent significant structural defects recorded	No works presently required	20+	C2	2.4
G024	Grey Poplar, Common Ash, Cherry, Silver Birch, Hawthorn, Lime, English Oak	To 10	To 200	To W-4	n/a	GL	Y-SM	Planted earth mound. Screening function. Good vitality throughout. Mutual crown suppression. No apparent significant structural defects recorded	Selective thinning	40+	B2	2.4
G025(0719)	Lime	5	To 150	To 2	n/a	1.8	Y	Formal linear planting. Beech hedgerow underneath. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	20+	C2	1.8
G026(0725)	Cherry	4	To 160	To 2	n/a	1.8	Y	3xcherry. Set in grassed area. Good vitality. Crowns toped at 4m.	No works presently required	20+	C2	1.9
018(0728)	Himalayan birch	5	120	2	1.8-N	1.8	Y	Growing in grassed area. Good vitality. No apparent significant structural defects recorded	No works presently required	20+	C2	1.4
G027	Common Ash	6	To 145	To 2	n/a	1.8	Y	Linear planting, shrubs underneath. Good vitality throughout, no apparent significant structural defects recorded	No works presently required	20+	C2	1.7

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM/EM/M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20+/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
019(0807)	Horse Chestnut	6	300	5	1.8-N	2	SM	Growing in grassed area. Footpath to north. Good vitality. Crown break at 1.8. No apparent significant structural defects recorded	No works presently required	20+	C2	3.6
G028	Flowering Cherry, Cockspur thorn	4	To 140	To 2	n/a	1	Y	3xtrees growing in grassed area. Good vitality throughout. Graft point for cherry at base. No apparent significant structural defects recorded	No works presently required	20+	C2	1.7
G029	Himalayan birch	To 5	To 80	1.5	n/a	1.5	Y	Group planting, shrubs underneath. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	20+	C2	1.0
G030(0803)	Weeping Ashx3	To 5.5	To 250	To 4.5	n/a	1.8	Y	Growing in grassed area. Weeping habits, crown breaks at 1.8m. Small diameter deadwood in crowns. Fair vitality throughout	No works presently required	20+	C2	3.0
G031	Not identified	To 3	To 90	To2.5	n/a	GL	Y	3xshrubs. Corner planted plot. Fair vitality throughout	No works presently required	10+	C2	1.1
G032(0796)	White beamx3	To 4.5	To 180	To 3	n/a	1.7	Y	Growing in grassed area. Good vitality throughout. Suckering growth on central tree. Decay entry points on stems at old branch wounds, not significant at present	Remove suckering growth	10+	C2	2.2
020(0800)	Whitebeam	8	To 240	3	2-E	1.8	SM	Growing in courtyard area. Crown break at 2m into 3xstems. Birds nest in crown. Ground compaction at base.	No works presently required	20+	B1	2.9
G033(0784)	Whitebeam, Crab Apple	To 8	To 250	To 3.3	n/a	1	Y	Growing in grassed area. Decay entry points on mains, at old branch wounds. Fair to good vitality throughout. Small diameter deadwood in crowns.	0785-elongated cavity on south side of main st. No works presently required	20+	C2	3.0
G034(0776)	Silver Birch	To 12	To 270	To 4.5	n/a	1.8	SM	Growing on grassed mound. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	20+	B2	3.2
021	Flowering Cherry	4	190	1	n/a	1	SM	Good vitality. Graft point at ground level.	No works presently required	20+	B1/3	2.3
G035(0760)	Alderx3	To 12	To 400	To N-5	n/a	1.8	Y-SM	Growing on banks of pond. Single stems & co-dominant leaders. Good vitality throughout. Abrupt angles on branches and minor crown suppression. No apparent significant structural defects recorded	No works presently required	20+	B2	4.8
G036(0759)	Weeping Silver Pearx4	To 3.5	To 230	To 3	n/a	1.5	SM	Growing on banks of pond. Crowns lifted to 1.8m. Congested crowns, typical of species. Good vitality throughout	No works presently required	20+	B2	2.8

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/ W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G037(0756)	Weeping Willowx8	To 17	To 700	To N, W-9	n/a	1.5	EM	Group of 8 trees. Fair to good vitality throughout. Deadwood in crowns, competition for light & crown shading. Past crown reductions visible on 2xtrees with multi stem regenerated stems at pruning wounds. Remaining trees unmanaged. Kinked stem, slight leans. Hazard beams in crowns due to weighted tips on branches leading to horizontal cracks.	Crown reductions by 5m on trees not currently under a reduction programme.	20+	B2/3	8.4
022(0753)	Field Maple	10	200	N-5, S-2	1.8-N	1.5	SM	Growing in grassed area. Crown suppression to south. Small diameter deadwood in crown. Fair vitality	No works presently required	10+	C1	2.4
G038(0740)	Horse Chestnut	To 10	490	To 5.5	n/a	1.8	SM	Trees growing on earth mound. Mutual crown suppression. Small diameter deadwood in crowns given competition for light. Fair to good vitality. No apparent significant structural defects recorded	No works presently required	20+	B2	5.9
G039(0747)	Alderx3	16	280	To 4	n/a	1	SM	Trees growing on pond. Good vitality. Self-sown. Leans on stems. No apparent significant structural defects recorded	No works presently required	20+	C2	3.4
023(0744)	White Willow	14	480	4	2-S	1.8	SM	Tree growing on top of slopped grass bank. Good vitality throughout. Crown break at 2m. Upright habit.	No works presently required	20+	C2	5.8
G040	Cherry, English Oak, Lime	6	To 150	3	n/a	1.8	Y	Line of trees. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	20+	C2	1.8
G041	Field Maple, Elm, Alder, Hazel, Hawthorn,	To 10	To 200	To 3	n/a	GL	Y-SM	Boundary hedgerow & occasional trees. Predominantly self-set elm. Southside cut back for cycle way clearance. Fair vitality, deadwood in crowns. Gaps in line.	No works presently required	20+	C2	2.4
024(1562)	English Oak	19	1000	9.5	4-N	4	M	Trees growing on southern boundary. Prominent tree given size and scale. Good vitality. Minor ivy encroachment. Ditch directly north, restricts root zone in this direction.	No works presently required	40+	A1/2/3	12.0
G042	Weeping Willow	To 16	To 650*	To 8*	n/a	GL	EM	Trees growing on southern bank of pond. Crowns collapsed in places, tear outs at old branch wounds. No targets beneath trees, leave as deadwood habitat	No works presently required	20+	C2/3	7.8

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G043	Crack Willow	To 14	700	4	n/a	2	EM	Trees topped at 8m. Onset of decay at pruning wounds and multi stem regeneration at pruning wounds. Elongated cavities extending down from topping points with wood decay fungi and extensive heartwood decay evident. Bat boxes in crowns & ivy clad stems.	Maintain as reduced trees given weakened structural condition.	10+	C3	8.4
G044	Cherry	To 8	To 350	To 4	n/a	0.5	Y-SM	Growing on top of earth mound. West tree large split in main stem below crown break. No long term potential. East tree sap bleeds on stems and suppressed crown, not significant.	Fell west tree	<10	U	4.2
G045	Crab Apple	To 5.5	150	To 3	n/a	1.8	NP-Y	Good vitality. Tree stakes on 2xtrees. No apparent significant structural defects recorded	No works presently required	20+	C2	1.8
025(0787)	Silver Maple	14	650*	8, W-3	3-E	2	M	Ivy at base hindering full assessment. Crown break at 2m. Ivy encroachment on stem to 3m. Root zone restricted to north by existing hard surfaces.	No works presently required	20+	B1	7.8
G046(0789)	Silver Maple	12	320	To 4.5	n/a	2	Y-SM	Trees growing in island plots. Fair vitality, small diameter deadwood in crowns. Ivy encroachment on stems. Decay entry points at old branch wounds.	No works presently required	10+	C2	3.8
G047(0895)	London Plane	To 7	To 100	To 2	n/a	2	Y	Linear planting forming an avenue. Tree pits protected by grilles. Fair to good vitality.	No works presently required	40+	C2	1.2
G048(1030)	Hornbeam	To 5.5	To 140	To 2	n/a	2	Y	Car park planting. Good vitality throughout. Some clipped into square crowns. No apparent significant structural defects recorded	No works presently required	40+	C2	1.7
G049(1565)	Golden Ash	To 5.5	To 100	To 2	n/a	2	Y	Trees growing in courtyard, breathing gravel at base. Good vitality	No works presently required	40+	C2	1.2
026	Liquid Amber	7	130	3	2-S	2	Y	Growing in border. Fair vitality, relatively sparse crown	No works presently required	10+	C1	1.6
027(1564)	Tulip Tree	8	160	3	n/a	2	Y	Growing in breathing gravel. good vitality, no apparent significant structural defects recorded	No works presently required	40+	C1	1.9
G050	Apple, Silver Birch, Willow	To 4	To 75	To 2	n/a	2	NP	Various newly planted trees. Good vitality throughout.	No works presently required	40+	C2	0.9

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G051(1397)	Norway Maple	To 8	To 330	To 5	n/a	2	SM	Trees growing in grassed area. Good vitality throughout. Ground levels appear raised at bases, no buttress roots visible. Crown breaks at 2m. Pruning wounds in crowns. Tight forks.	clear soil from bases	20+	B2	4.0
G052	Snowy mespilus, Pear	To 8	To 180	To 4	n/a	GL	Y	Trees growing in grassed courtyard. Good vitality	No works presently required	40+	C2	2.2
G053	Snowy mespilus, Pear	To 8	To 180	To 4	n/a	GL	Y	Trees growing in grassed courtyard. Good vitality	No works presently required	40+	C2	2.2
G054	London Plane	To 9	To 200	To 4	n/a	1.8	Y	Linear planting. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	40+	B2	2.4
G055(1547)	Lime	To 9	To 350	To 4.5	n/a	1.8	SM	Line of trees. Good vitality throughout. Grassed area at base, car park to west. Surface root damage in places from mower activity. Crowns lifted and reduced. Stubs of deadwood in crowns.	No works presently required	40+	B2	4.2
G056(1541)	Lime	To 7	To 250	To 3.5	n/a	1.8	Y	Crescent planting. Grassed area at bases. Good vitality throughout, no apparent significant structural defects recorded	No works presently required	40+	B2	3.0
028(1493)	Norway Maple	12	620	7	2-E	2	M	Prominent tree. Grass area at base. Fair vitality, small diameter deadwood in crown. Crown break at 2m into multi stems, dieback on central leader. Seams of reaction wood extending down from union, potential reaction wood to internal crack.	PiCUS sonic tomograph to determine internal condition of main stem beneath multi-stem union.	20+	B1*	7.4
029(1532)	Apple	5	160	3	1-S	1.5	Y	Growing in grassed area. Mower damage base. Crown break at 1m, good vitality	No works presently required	10+	C1	1.9
030(1530)	Lawson Cypress	9	260	3	n/a	0.5	SM	Growing in grassed area. Crown suppressed to west. Fair vitality	No works presently required	10+	C1	3.1
G057(1529)	Lime	To 14	To 400	To 6	n/a	2	EM	Avenue feature. Good vitality throughout. Occasional tight forks in canopies, not significant at present. Crowns lifted to 2m. No apparent significant structural defects recorded	No works presently required	40+	A2	4.8
G058(1519)	Lime	To 7	To 130	2	n/a	1.5	Y	Line of trees. Grass at bases, fair vitality throughout. Snapped branches in crowns, remaining wounds frayed.	Formative prune	20+	C2	1.6
031(1854)	Luscomb Oak	16	750	9	2.5-E	2	EM	Growing in grassed area. Good vitality. Crown break at 2.5m. Balanced form. No apparent significant structural defects recorded	No works presently required	40+	A1	9.0

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20+/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
032	Common Ash	18	500, 650	S-9.5	5-E	3	M	Growing on bank of ditch on northern boundary. Heavy ivy encroachment on stems to 16m, obscuring full assessment. Dead branches on ground and hung-up in canopy. Fair vitality	Sever ivy at base, remove deadwood overhanging footpath	20+	B2	9.8
033	Sycamore	18	700x3*	S-9	6-S	2	M	Growing on bank of ditch on northern boundary of site. Fair vitality, heavy ivy encroachment on stems obscuring full assessment of crown condition. 3xstems at base. Garden debris piled at base, not accessible.	Sever ivy at base, remove deadwood overhanging footpath. Remove garden debris at base to facilitate ongoing tree condition assessments.	20+	B2	14.9
034(1897)	Field Maple	14	500	8, N-4	3-E	3	EM	Good vitality. Crown suppressed to north. Bat box in crown. No apparent significant structural defects recorded. Animal grazing at base	No works presently required	40+	B2	6.0
035(1896)	Field Maple	14	330	N&W-1.5, 6,	2-W	2	SM	Fair vitality. Crown suppressed to north & west. Bark removed in places on main stem from grazing cattle. Small diameter deadwood in crown	No works presently required	10+	C1	4.0
036(1895)	English Oak	18	860	S-9, W-8, E-6, N-5	2-S	1	M	Good vitality. Crown break at 2m. Rubbing branches in crown. Minor suppression to north & west. No apparent significant structural defects recorded	No works presently required	40+	A1	10.3
G059(1508)	Common Beech	To 18	530	To 7.5	n/a	2	SM-EM	Positioned at end of lime avenue. Good vitality. Single stems to 5-9m before co-dominant leaders. No apparent significant structural defects recorded	No works presently required	40+	A2	6.4
037	English Oak	14	1100	13, W-7	1-S	1	EM	Growing in grassed area. Low crown height, crown break at 1m. Squat form. Large diameter deadwood in crown to west. Drainage channel to west. Loss of apical dominant leader. Fair to good vitality	No works presently required	40+	A1	13.2
038(1892)	English Oak	20	990	13	2-W	1.5	M	Growing in grassed area. Good vitality. Central leader splits into multi stem form at 7m. Prominent tree.	No works presently required	40+	A1	11.9
039(1891)	English Oak	17	890	11, N-8	2-E	2	EM	Growing in grassed area. Good vitality. Small diameter deadwood in crown. Crown break at 2m. No apparent significant structural defects recorded	No works presently required	40+	A1	10.7

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM/EM/M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20+/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G060	Cherry, Elder, Hazel, Sycamore, Lawson Cypress, Common Ash		280	To 5	n/a	GL	Y-EM	Corner plot. Informal group of self-sown & planted trees growing around cottage. Heavy ivy encroachment on stems in places, heavy clematis growth on some conifers. Drawn stems. Fair vitality. deadwood in crowns. Limited targets around trees.	No works presently required	20+	C2	3.4
040	Hybrid Black Poplar	20	910	8	3-S	2	M	Growing within G060. Ivy encroachment on main stem to 5m. Open crown form. Seams of reaction wood on main stem indicative of adaptive wood to compensate for an internal cracks. Not significant at present	No works presently required	20+	C1/2	10.9
041(1494)	English Oak	15	460	7, N-4	2-S	2	SM	Part of avenue, suppression to north. Good vitality. Co-dominant leaders at 5m, union appears sound. No apparent significant structural defects recorded	No works presently required	40+	B1/2	5.5
042	Blue Atlantic Cedar	10	330	5	1-S	1.5	SM	Growing in grassed area. Good vitality. No apparent significant structural defects recorded	No works presently required	40+	B2	4.0
043(1497)	Silver Maple	16	910	17, N-9.5, S-11	2-S	2	M	Growing in grassed area. Crown break at 2m. Open crown form. Pronounced buttress roots to east & west. Crown tip pruned. Good vitality.	No works presently required	20+	B2	10.9
044(1398)	Norway Maple	5	540	8	2-S	1.8	EM	Growing in grassed area. Good vitality. Crown break at 2m. No apparent significant structural defects recorded	No works presently required	20+	B2	6.5
G061(1448)	Silver Birch	To 13	To 330	To 7	n/a	2	Y-SM	Growing in grassed area & field boundary. Line of trees. Fair to good vitality throughout, with small diameter deadwood in crowns. Cavities on main stems at old branch wounds or animal grazing damage. Leans on stems. Dieback on branches. 1436-elongated cavity on south side of main stem.	No works presently required	20+	C2	4.0
G062(1445)	Norway Maple	13	To 390	To 6	n/a	2	SM	Growing in grassed area. Good vitality throughout. Mutual crown suppression. No apparent significant structural defects recorded	No works presently required	20+	B2	4.7
045(1440)	Cappadocian Maple	12	440	S-3, 8	2-S	2	SM	Part of line of trees. Dense suckering growth at base. Elongated cavity on westside of main stem from animal grazing. White rot present. Good vitality	No works presently required	20+	C2	5.3
G063	Leyland cypress	10	To 450	To 4	n/a	0.5	SM-EM	Hedgerow planting. Topped at 5m. Fair to good vitality throughout.	No works presently required	10+	C2	5.4

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
046(1426)	Cappadocian Maple	6	350	4.5, E-4	2-N	2	SM	Growing in grassed area, aggregate in root zone to east. Good vitality. Suckering growth cut down. No apparent significant structural defects recorded	No works presently required	20+	C1	4.2
G064(1423)	Flowering Cherry	To 4.5	To 350	To 4.5	n/a	1.6	SM-EM	Informal group growing in grassed area. Grafted trees, graft points at bases. Good vitality throughout. occluding pruning wounds in crowns,	No works presently required	20+	B2	4.2
047	Elder	4	80x5	W-3	n/a	GL	SM	Self-sown tree, growing immediately adjacent to building. Fair vitality. No long term potential	No works presently required	<10	C1	2.1
048(1420)	Black Mulberry	5	360	N-7, 5	1.6-N	1.8	SM	Growing in grassed area. Good vitality. Crown break at 1.6m into 5xstems. Crown reduced to south & east for building clearance.	No works presently required	20+	B1	4.3
049(1419)	Flowering Cherry	7	360	5.5	2-NE	2	EM	Growing in grassed area. Services to south. Grafted tree. Good vitality. Co-dominant leaders at 2m. No apparent significant structural defects recorded	No works presently required	20+	B1	4.3
G065(1470)	Cherry	To 7	To 355	To E-5.5	n/a	2	SM-EM	Growing in line in grassed area. Mutual crown suppression. Fair to good vitality with small diameter deadwood in crowns. Crown breaks at 1.6m. 1470-elongated cavities on south & west stems from unions with main stem to 400mm. Heartwood decay evident, reaction wood on periphery of wounds. Not significant at present	1470-cavity extends to full branch extents. Reduce to 1m.	10+	C2	4.3
G066(1461)	Silver Birch	To 14	To 390	To 7	n/a	2	SM-EM	Line of trees, grassed area at bases. Mutual crown suppression throughout. Localised dieback of shaded limbs. Stubs of small diameter deadwood. Decay entry points at old branch wounds. Not significant at present.	No works presently required	20+	B2	4.7
G067(1474)	Lime	To 14	To 360	To 5.5	n/a	2	SM-EM	3xtrees. Grassed area at bases. Crown breaks at 2m. Crossing & rubbing branches throughout. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	20+	B2	4.3
050(1475)	Sweet Gum	4.5	160	2	n/a	2	Y	Good vitality, no apparent significant structural defects recorded	No works presently required	20+	C1	1.9
051(1476)	Norway Maple	4	150	2	n/a	2	Y	Good vitality, no apparent significant structural defects recorded	No works presently required	20+	C1	1.8

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM/EM/M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20+/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G068(1456)	Norway Maple	To 14	To 545	To 6.5	n/a	2	SM-EM	Informal group, growing in grassed area. Good vitality throughout, mutual crown suppression. Small diameter deadwood in crowns through shading. Crown breaks at 1.5m into multi stem forms. Crossing & rubbing branches in crowns , not significant at present	No works presently required	20+	B2	6.5
G069(1452)	Silver Maple	To 16	To 740	To 14	n/a	2	EM-M	Informal group growing in grassed area. Good vitality throughout. Crown breaks at 2m into multi stem forms. Large broad open crowns. Branches tip pruned in the past away from built infrastructure. Exposed surface roots, scalped in places by mower activity.	No works presently required	20+	B2	8.9
G070(1450)	Crab Apple	To 7	370	To 7	n/a	1.8	EM	Growing in grassed area. Fair to good vitality. Small diameter deadwood in crowns. 1450-leans to east, no root heave visible, not significant at present	No works presently required	20+	B2	4.4
052(1449)	Crab Apple	2.5	180	2.5	1.5-W	1.5	Y	Grafted tree. Good vitality. Dense canopy at 1.5m.	No works presently required	20+	C1	2.2
G071(1409)	Whitebeam	To 10	To 450	To 6	n/a	1.8	EM	Line of trees. Crown breaks at 2m into multi stem forms. Small diameter deadwood in crowns, slight leans on stems. Crowns directionally pruned away from built infrastructure.	1413-Ganoderma fungal brackets at base-fell	20+	B2	5.4
053	Elder	6	230	3.5, S-0	n/a	0.5	SM	Tree growing immediately adjacent to building. Fair vitality.	No works presently required	10+	C1	2.8
G072(1401)	Norway Maple	To 11	To 340	To 4.5	n/a	2	SM	Line of trees growing in grassed area. Fair vitality. Deadwood in crowns-small & large diameter. 1405, 1406-extensive dieback in crowns, within falling distance of target areas.	Remove deadwood in crowns. Fell 1405 &1406	<10	U, C2	4.1
054	Silver Birch	7	240	4	n/a	1	SM	Sparse crown. Loss of apical dominant leader. Cavities on main stem, deadwood at base.	fell on the grounds of safety & sound arboricultural management	<10	U	2.9
G073(1392)	Hornbeam	To 5.5	To 140	To 2	n/a	2	Y	Car park planting. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	40+	C2	1.7
055(1477)	Hornbeam "fastigata'	6	280	4	n/a	1.5	Y	Good vitality. Growing in grassed area. No apparent significant structural defects recorded	No works presently required	40+	C1	3.4

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G074	Silver Birch	To 14	To 330	To 5.5	n/a	1.5	SM-EM	Growing in garden area. Good vitality throughout. Mutual crown suppression. No apparent significant structural defects recorded	No works presently required	20+	B2	4.0
056	Sycamore	9	80<10	To 4.5	n/a	0.5	SM	Multi stem form, past coppice management. Good vitality, drawn stems	No works presently required	10+	C1	3.0
G075	Elder, Silver Birch, Alder,	To 6	To 180	To 3.5	n/a	0.5	NP-Y	Part of garden border. Mix of trees and shrubs. Good vitality, no apparent significant structural defects recorded	No works presently required	40+	C2	2.2
057	Silver Birch	9	330	5	2-S	2	SM	Fair vitality, small diameter deadwood in crown. Mechanical disturbance in root zone from levelling and grass seeding. No surface roots visible. Minor ivy encroachment on stem.	No works presently required	10+	C1	4.0
058(1490)	Silver Maple	7	250	3	2-S	2	Y	Growing in grassed area in car park. Good vitality, slight lean to east.	No works presently required	20+	C1	3.0
059	Crab Apple	4	120	2	n/a	1.8	Y	Growing in nursery area, good vitality	No works presently required	20+	C1	1.4
G076	London Plane	To 8	To 160	To 3	n/a	1.8	Y	Avenue feature. Metal grilles at bases. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	40+	B2	1.9
G077(1370)	Lime	To 10	To 450	To 6	n/a	1.8	Y-SM	Line of trees. Grassed area at bases. 2xyoung & 2xsemi-mature. Good vitality throughout. Girdling roots snapped. Small diameter deadwood in crowns. Crowns lifted for car park clearance.	No works presently required	40+	B2	5.4
060	Horse Chestnut	6	210*	4, W-0	1-S	0.5	Y	Tree not accessible, within building site. Good vitality. Mechanical disturbance in root plate	No works presently required	10+	C1	2.5
061	Field Maple	8	500	5, E-3	1-S	0.5	SM	Tree not accessible, within building site. Good vitality. Mechanical disturbance in root plate	No works presently required	10+	C1	6.0
G078	Field Maple, Black thorn	To 7	To 400	To 4.5	n/a	GL	SM-EM	Old field boundary hedgerow. Limited trees remaining. Multi stem forms, suggesting past topping. Building welfare facilities to north. Fair vitality	No works presently required	10+	C2	4.8
G079	Hornbeam	To 5.5	To 140	To 2	n/a	2	Y	Car park planting. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	40+	C2	1.7
G080	London Plane	To 6	To 100	To 2.5	n/a	2	Y	Avenue feature. Good vitality throughout. Metal grilles at bases.	No works presently required	40+	C2	1.2

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G081	London Plane	To 6	To 100	To 2.5	n/a	2	Y	Avenue feature. Good vitality throughout. Metal grilles at bases.	No works presently required	40+	C2	1.2
G082	Hornbeam	To 5.5	To 140	To 2	n/a	2	Y	Car park planting. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	40+	C2	1.7
062(1084)	Apple	6	160	3	n/a	1.8	Y	Good vitality. Growing in raised border. Snapped branch in crown	Formative prune	20+	C1	1.9
G083	Sorbus spp	To 6	To 100	To 2.5	n/a	1.8	Y	Good vitality, no apparent significant structural defects recorded	No works presently required	40+	C2	1.2
G084	London Plane	To 6	To 100	To 2.5	n/a	2	Y	Avenue feature. Good vitality throughout. Metal grilles at bases.	No works presently required	40+	C2	1.2
G085	Hornbeam	To 5.5	To 140	To 2	n/a	2	Y	Car park planting. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	40+	C2	1.7
G086	Various	To 6	To 100	To 2.5	n/a	2	Y	Avenue feature. Good vitality throughout. Metal grilles at bases.	No works presently required	40+	C2	1.2
W1	Ash, Field Maple, English Oak, Hawthorn, Hazel	To 6	To 200	To 3	n/a	GL	Y-SM	Screen planting on earth mound. 3m centre spacing. Fair to good vitality throughout. New planting to front. No apparent significant structural defects recorded	No works presently required	40+	C2	2.4
W2	Ash, Field Maple, English Oak, Hawthorn, Hazel	To 6	To 200	To 3	n/a	GL	Y-SM	Screen planting on earth mound. 3m centres spacing. Fair to good vitality throughout. New planting to front. No apparent significant structural defects recorded	No works presently required	40+	C2	2.4
063	English Oak	16	1100	9	3-E	1	M	Prominent tree. Old field boundary tree. Dead ivy throughout crown. Co-dominant leaders at 3m. Good vitality. Ditch to north. No apparent significant structural defects recorded	No works presently required	40+	A1/2/3	13.2
064	English Oak	16	1050	7, N&S-9	3-W	3	M	Prominent tree. Old field boundary tree. Crown break at 3m into multi stem form, suggesting old pollard. Good vitality. Ditch to north. No apparent significant structural defects recorded	No works presently required	40+	A1/2/3	12.6
065	English Oak	18	1000	7, N&S-10	5-N	1.5	M	Prominent tree growing on ditch. Old field boundary tree. Crown break at 5m. Good vitality, small & moderate size deadwood in crown. Good habitat value.	No works presently required	40+	A1/2/3	12.0

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
066(1839)	English Oak	18	1200	8	2-E	1	M	Prominent tree growing close to water feature. Old field boundary tree. Dead ivy throughout crown. Good vitality small diameter deadwood in crown. No apparent significant structural defects recorded	No works presently required	40+	A1/2/3	14.4
067(1829)	English Oak	14	900	7.5	3-S	1	M	Prominent tree growing immediately adjacent to water feature. Old field boundary tree. Crown break at 4m into 3xstems. Slight lean on stems, correcting at 6m. Good vitality. No apparent significant structural defects recorded	No works presently required	40+	A1/2/3	10.8
068(1826)	English Oak	14	520, 460	7	2-S	1	M	Old field boundary tree. Co-dominant leaders at 1m. Old branch wound at base to south east, decay at wound-not significant at present. Kinked main stems. Relatively sparse crown, small diameter deadwood in crown.	Apply liquid fertiliser to base to improve vitality.	40+	B1/2/3	8.3
G087	English Oakx2	To 14	To 580	To 6.5	n/a	2	SM	Part of old field boundary. Good vitality. 2xtrees. Co-dominant leaders and multi stem forms from 2m. Small diameter deadwood in crowns.	No works presently required	40+	B1/2/3	7.0
G088(1820)	Common Ash	To 12	To 410	To 6	n/a	GL	SM	Line of trees. Ground disturbance at bases. Fair vitality throughout, deadwood in crowns. Bark wounds on stems. Basal limbs. Frayed branch wounds.	Crown clean	20+	C2	4.9
W3	Field Maple, Common Ash, Elder, Blackthorn, English Oak, Scots Pine	To 16	To 300	To 6	n/a	GL	SM	Woodland block. Diagonal rows, 3m centres. Screening function. No active management visible. Woodland edge to west. Fair to good vitality throughout.	Selective thinning	40+	B2	3.6
W4	Field Maple, Common Ash, Elder, Blackthorn, Sycamore	To 10	To 300	To 6	n/a	GL	SM	Woodland block. Screening to M11, 3m centres. Screening function. No active management visible. Fair to good vitality throughout.	Selective thinning	40+	B2	3.6
G089	Beechx2	To 5	To 180	To 3	n/a	GL	Y	Growing on corner of field. Good vitality throughout, no apparent significant structural defects recorded	No works presently required	20+	C2	2.2
G090	Crab Apple, Hawthorn, Elder	To 8	To 400	To 4	n/a	GL	SM	Old field boundary hedgerow. 5xindividual crab apple trees-crown lifted to 3m. Hedgerow topped at 2m. Decay entry points, old branch wounds. Fair to good vitality. Western extents not topped. Gaps in places. Ivy clad stems.	No works presently required	20+	C2	4.8

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM /EM/ M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20 +/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
069	Common Ash	8	260	5	2-NE	2	Y	Fair vitality. Bark stripped at buttress roots. Rabbit damage. Ground disturbance at base	No works presently required	10+	C1	3.1
G091	Hornbeam, Hawthorn	To 7	To 300	To 6	n/a	GL	SM	Old field boundary hedgerow. Gaps in places. No recent management. Multi stem forms at ground level or at 2m. Past coppice or topping. Fair to good vitality throughout	No works presently required	20+	C2	3.6
070(1579)	Service tree	14	750	8	4-S	3	M	Growing on west boundary. Adjacent to footpath. Small to moderate deadwood in crown. Frayed old branch wounds. Dieback in upper canopy. Fair vitality	Remove deadwood in crown overhanging footpath	20+	B2/3	9.0
G092(1170)	Sorbus spp	To 6	To 150	To 2.5	n/a	2	Y	Good vitality. No apparent significant structural defects recorded	No works presently required	20+	C2	1.8
G093(1169)	Hornbeam 'fastigata'	To 14	To 470	To 5	n/a	1	SM-EM	Intermittent trees in car park area. Good vitality. Upright growth habit. No apparent significant structural defects recorded	Crowns lifted for car park clearance No works presently required	20+	B2	5.6
071	Honey locust	9	550	5, E&W-3	1.5-SE	2	SM	Growing in planted border. Fair vitality, crown thinned. Small diameter deadwood in crown. Relatively sparse crown.	Clear shrubs to 1m radius around tree to improve vitality, remove deadwood in crown overhanging car park	10+	C1	6.6
G094(1151)	Silver Birch x2	To 10	To 280	To 4	n/a	1.5	Y-SM	Growing in car park. Good vitality. Mutual crown suppression. No apparent significant structural defects recorded	No works presently required	20+	C2	3.4
G095(1153)	Hornbeamx3, Silver Birchx1, Alder x3	To 9	To 260	To 3.5	n/a	1.5	Y-SM	Growing in car park. Good vitality. No apparent significant structural defects recorded. Crowns lifted for car park clearance	No works presently required	20+	C2	3.1
072(1156)	Alder	14	360	5	3-W	1.5	SM	Growing in car park. Slight lean on main stem. Good vitality. No apparent significant structural defects recorded. Crown lifted for car park clearance.	No works presently required	20+	B1	4.3
G096	Mixed	To 3.5	To 120	To 2	n/a	1.5	Y	Mixed trees growing in car park area. Fair to good vitality throughout	No works presently required	20+	C2	1.4
G097(1185)	Mixed	To 7	To 220	To 3.5	n/a	1.5	Y	Growing in grassed area. Good vitality throughout. Small diameter deadwood in crowns. No apparent significant structural defects recorded. Fair vitality. Dieback in crowns	No works presently required	20+	C2	2.6
073(1184)	Honey locust	8	360, 470	S-6, 4.5	2-N	2	SM	Growing in planted border. Co-dominant leaders at base. Crown thinned. Pruning wounds present. Stubs of small diameter deadwood in crown and localised dieback.	Remove deadwood in crown overhanging target areas.	10+	C1	7.1

ATKINS

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM/EM/M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20+/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G098(1181)	Weeping birchx6	5	To 220	To 4.5	n/a	1.5	Y-SM	Informal group growing in grassed area. Pendulous habit from 2-3m. Fair vitality throughout. Contorted stems & small diameter deadwood in crowns.	No works presently required	20+	C2	2.6
074	Blue Atlantic Cedar	12	450	6	1-SE	1	SM	Good vitality. Growing in grassed area. Crown break at 1.8m. No apparent significant structural defects recorded	No works presently required	20+	B1	5.4
G099(0216)	Scots Pine, White Beam, Silver Birch, Cherry, Elder, Alder, Lawson's Cypress, Goat Willow, Field Maple,	To 7	To 250	To 3.5	n/a	0.5	Y-SM	Part of car park planting. Fair to good vitality throughout. Multi stem & single stems. No apparent significant structural defects recorded	No works presently required	20+	C2	3.0
075	Alder	10	300	N-4	2-N	0.5	SM	Part of car park area. Lean on main stem to north. Correcting at 2m. Good vitality, single leader.	No works presently required	20+	B1	3.6
G100	Callery Pearx4	To 6	To 200	To 2.5	n/a	1.5	SM	Part of garden area. Good vitality throughout. No apparent significant structural defects recorded	No works presently required	20+	C2	2.4
076	Lawson's cypress	2.5	190	1.5	n/a	0.5	Y	Tree topped at 2M. Part if car park area. Fair vitality	No works presently required	10+	C1	2.3
G101(1234)	Silver Birch	To 14	To 340	To 5	n/a	3	Y-SM	Informal group of trees. Grassed area at bases. Crowns lifted to 3m, un-occluded pruning wounds on stems. Mutual crown suppression, small diameter deadwood in crowns. Fair to good vitality throughout.	No works presently required	20+	B2	4.1
G102(1250)	Norway Maple	To 10	To 350	To 6	n/a	4	Y-SM	Line of trees in car park area. Crowns lifted for car park clearance. Un-occluded pruning wounds on stems. Fair vitality throughout. No apparent significant structural defects recorded	No works presently required	20+	C2	4.2
G103	Silver Birchx3	5	80	2	n/a	1	Y	Good vitality. Growing in grassed planted border	No works presently required	20+	C2	1.0
G104(1223)	Norway Maple x3, Scots Pine x1	To 10	To 160	To 4	n/a	1	Y	Good vitality. Growing in grassed planted border	No works presently required	20+	C2	1.9
G105	Silver Birch, Hawthorn Scots Pine, Lime, Whitebeam.	To 14	To 360	To 5	n/a	1	Y-SM	Boundary tree planting. Excavation works to north. Mutual crown suppression throughout. Drawn stems. Fair to good vitality throughout. No apparent significant structural defects recorded	No works presently required	20+	B2	4.3

Tree no.	Species in group	Ht (m)	Stem diameter (mm)	Branch spread (m) N/E/S/W	1st major branch height (m) & direction N/E/S/W	Canopy height (m)	Life stage Y/SM/EM/M/OM	General observations structural and/or physiological condition	Preliminary management recommendations	Estimated Remaining contribution (years) <10/10+/20+/40+	Category grading A/B/C/U 1/2/3	Root Protection Area Radius (m)
G106(1341)	Horse chestnutx2, Limex1	To 7	To 200	To 4	n/a	1	Y	Growing in grassed area on northern boundary. Good vitality throughout, no apparent significant structural defects recorded	No works presently required	20+	C2	2.4
G107(1346)	Cherry	To 7	To 260	To 4.5	n/a	2	SM	Line of trees. Crowns lifted to 2m. Good vitality throughout, sap bleeds on stems, not significant. No apparent significant structural defects recorded	No works presently required	20+	B2	3.1
G108	Common Ash, Whitebeam	To 8	To 230, 140	To 5	n/a	1.5	Y	Existing & planted trees around pond. Drawn stems. Fair vitality throughout. Poor structural condition on Whitebeams, limited long-term potential. Stripped bark and extensive wounds on stems.	No works presently required given limited access to trees.	20+	C2	3.2
G109(1358)	Cherry, Lime	To 8	To 260	To 6	n/a	1.5	Y	Lines of trees on boundary & extending south into site. Excavation works to north of boundary trees. Fair to good vitality throughout. No apparent significant structural defects recorded	No works presently required	20+	C2	3.1
G110	Various	T0 5	To 150	To 2	n/a	1.5	NP	Various newly planted trees within landscape areas and along highway infrastructure. Good vitality throughout	No works presently required	40+	C2	1.8

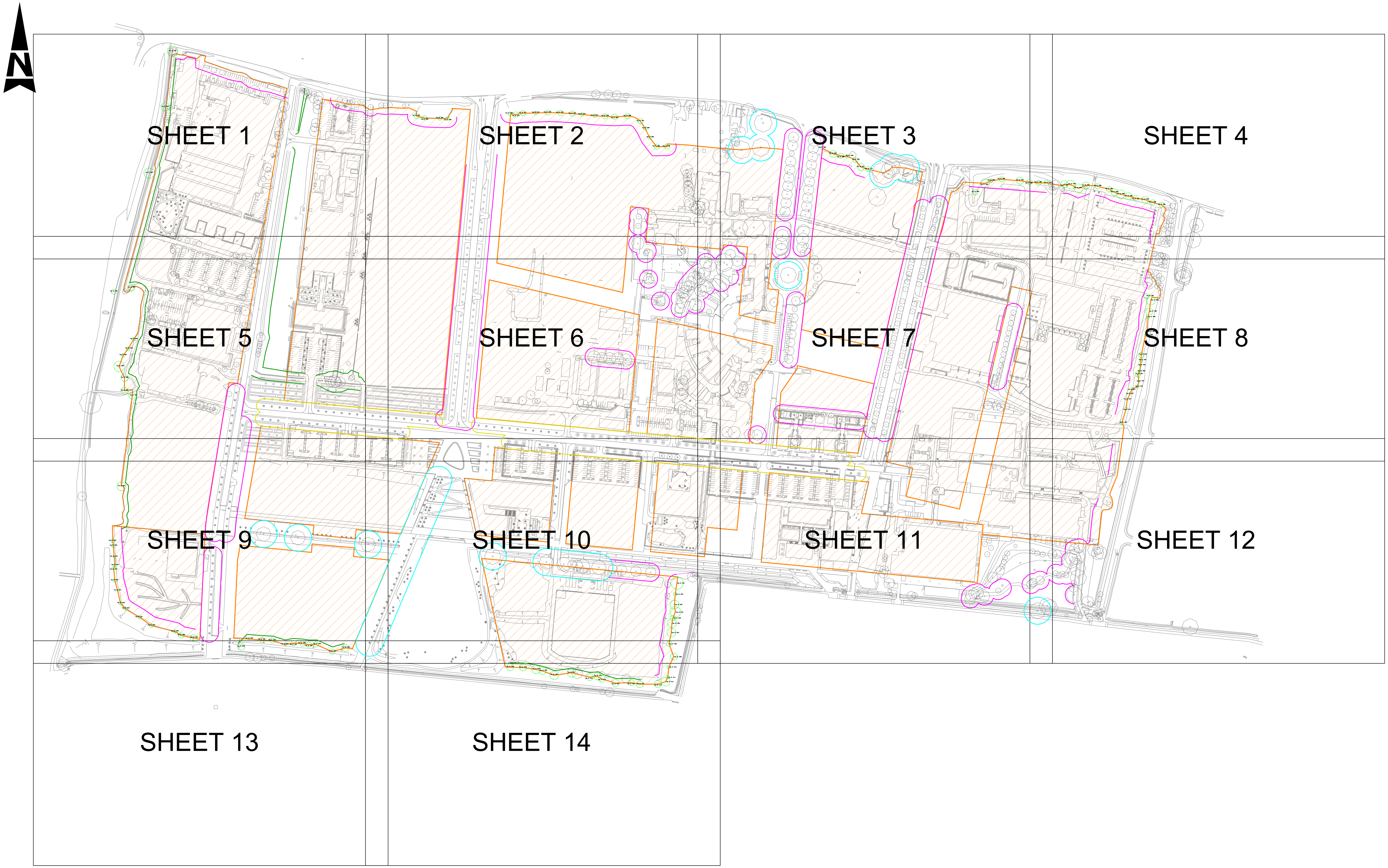
Appendix C. Glossary of terms

Term	Description
Access Facilitation Pruning	One-off tree pruning operation, the nature and effects of which are without significant adverse impact on tree physiology or amenity value, which is directly necessary to provide access for operations on site.
Adaptive Growth	The process whereby wood formation is influenced both in quantity and in quality by the action of gravitational force and mechanical stresses on the cambial zone
Amenity Value	The environmental and landscape benefits of trees as opposed to their commercial value for timber
Ancient Woodland	Sites which have been wooded since at least 1600, as defined by English Nature and recognised as being of high nature conservation value, whether managed or not. They may be semi-natural or replanted.
Arboricultural Method Statement	Methodology for the implementation of any aspect of development that is within the root protection area, or has the potential to result in loss of or damage to a tree to be retained.
Arboriculture	The study and care of trees and other woody vegetation
Arboriculturist	A person who has, through relevant education, training and experience, gained expertise in the field of trees in relation to construction.
Cavity	An open wound, characterised by the presence of decay and resulting in a hollow
Co-dominant stems	Where a trees main stem splits into two leaders, can also be called twin-stemmed.
Competent person	A person who has training and experience relevant to the matter being addressed and an understanding of the requirements of the particular task being approached.
Construction	Site-based operations with the potential to affect existing trees.
Construction Exclusion Zone	The area based on the root protection area from which access is prohibited for the duration of a project.
Coppice	A traditional method of woodland management in which young tree stems are repeatedly cut down to near ground level. In subsequent growth years, many new shoots will emerge, and, after a number of years the coppiced tree, or *stool*, is ready to be harvested, and the cycle begins again
Crown clearance	This is the removal of all dead, dying and diseased branches; in addition branches that are cleared away from a specific hazard e.g. live railway line.
Crown lifting	The removal of lower branches to provide a desired amount of clearance above ground level. This can be achieved either by the complete removal of a branch or only parts of which extend below the desired height
Crown reduction	The overall reduction of both the height and spread of the crown.
Decay	Process of degradation of woody tissues by fungi and bacteria through decomposition of cellulose and lignin.

Term	Description
Deadwood	Deadwood is often present within the crown or on the stems of trees. In some instances is may be an indication of ill health, however, it may also indicate natural growth processes. If a target is present beneath the tree, deadwood may fall and cause injury or damage and should be removed, otherwise deadwood can remain intact for conservation purposes (insects, fungi, birds etc.).
Epicormic growth	A secondary growth from dormant adventitious buds on the stem or main braches.
Failure	In connection with tree hazards, apartail or total fracture within woody tissue or loss of cohesion between roots and soil.
Hazard beam	An branch that has over extended in which strong internal stresses may occur without the compensatory formation of extra wood (longitudinal splitting may occur in some cases).
Hung-up limb	Dead or fallen branch from within the crown or from another tree's crown that has failed and been caught up by, and resting on, branches of a tree
Included Bark Junction	Pattern of development at branch junctions where bark is turned inward rather than pushed out. Potential weakness due to a lack of a woody union.
Ivy Growth	Ivy growth may ascend into the tree's crown, increasing wind resistance, concealing potential defects and reducing the tree's photosynthetic capacity. Ivy growth is often acceptable in woodland areas as a conservation benefit.
Monolith	A large bulk of standing dead wood. Usually the truck of the tree or the truck with the base of the branch frame work. These should be retained for wildlife habitat when the risk is appropriate for the location.
Pollarding	This involves the removal of whole branches to leave only the main trunk. In species such as willows and poplars such as significant pruning is acceptable with new branches developing from the pollard heads. Secondary pruning of the new wood can help form a new canopy to the tree several years after the initial pollard
Reaction Wood	Specialised secondary xylem, which develops in response to a lean or similar mechanical stress, attempting to restore the stem to the vertical.
Root Protection Area (RPA)	The layout design tool indicating the minimum area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree's viability, and where the protection of the roots and soil structure is treated as a priority.
Service	Any above or below ground structure or apparatus required for utility provision.
Stem	The principal above-ground structural component(s) of a tree that supports its branches.
Structure	A manufactured object, such as a building, carriageway, path, wall, service run, and built or excavated earthwork.
Structural Defect	Internal or external points of weakness, which reduce the stability of the tree
Sub-dominant stem	A branch within the crown that is not the dominant leader
Suppressed	Trees which are dominated by surrounding vegetation and whose crown development is restricted from above.

Term	Description
TPO	A Tree Preservation Order is an order made by Local Planning Authority which in general makes it an offence to cut down, lop, top, uproot, wilfully damage or wilfully destroy a tree without first getting permission from us. Tree Preservation Orders are usually made to protect trees that make a significant contribution to the amenity of an area. They may particularly be made when it is felt that a tree may be under threat.
Tree Constraints Plan	Abbreviated to TCP. Plans showing specific tree constraints including Root Protection Areas and Crown spread.
Tree Protection Plan	Abbreviated to TPP. Scaled drawing, informed by descriptive text where necessary, based upon the finalised proposals, showing trees for retention and illustrating the tree and landscape protection measures.
Veteran Tree	A tree that, by recognised criteria, shows features of biological, cultural or aesthetic value that are characteristic of, but not exclusive to, individuals surviving beyond the typical age range for the species concerned. These characteristics might typically include a large girth, signs of crown retrenchment and hollowing of the stem.
Visual Tree Assessment	A non-invasive method of examining the health and structural condition of trees. Developed by Claus Mattheck and David Breloer 1994
Wound	Any injury, which induces a compartmentalisation response
Wound Wood	Wood with atypical anatomical features, formed in the vicinity of a wound and a term to describe the occluding tissues around a wound as opposed to the ambiguous term "callus."

Appendix D. Drawings



Stat	Purpose of Issue	Date	Auth
P	PLANNING	12/04/16	TD

Rev	Description	By	Date	Chk'd	Auth
E	MINOR AMENDMENT TO KEY	BC	13/06/17	TD	TD
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B	AMENDED DEVELOPMENT ZONES	AA	07/02/17	TD	TD
A	RETENTION OF TREE GROUP G064	BC	17/05/16	TD	TD
–	ORIGINAL PLANNING ISSUE	BC	12/04/16	TD	TD

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Client: UNIVERSITY OF CAMBRIDGE

Project: WEST CAMBRIDGE MASTERPLAN (EIA)

Title: TREE PROTECTION PLAN KEY

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A1	1:2000	BC, Date 07/02/17	TD, Date 07/02/17	TD, Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_00	E

TREE PROTECTION KEY

000	CATEGORY A TREE + TREE REF.
000	CATEGORY B TREE + TREE REF.
000	CATEGORY C TREE + TREE REF.
000	CATEGORY U TREE + TREE REF.
G1	TREE GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)
W1	WOODLAND GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)
	ROOT PROTECTION AREA
	REFER TO GROUP G110
	BUILDING ZONES
+	NON-MANDATORY TREE TO BE RETAINED WHERE POSSIBLE
	NON-MANDATORY TREE GROUP TO BE RETAINED WHERE POSSIBLE
	5M BUFFER FROM TREE STEM TO BUILDING EDGE
	8M BUFFER FROM TREE STEM TO BUILDING EDGE
	10M BUFFER FROM TREE STEM TO BUILDING EDGE
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Title: TREE PROTECTION PLAN SHEET 1

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A1	1:500	BC, Date 07/02/17	TD, Date 07/02/17	TD, Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_01	E

TREE PROTECTION KEY

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	REFER TO GROUP G110
	BUILDING ZONES
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	NON-MANDATORY TREE GROUP TO BE RETAINED WHERE POSSIBLE
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Title
TREE PROTECTION PLAN
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Project
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Status	Drawing Number	Rev
P	5137998_COL_ARB_02	E

TREE PROTECTION KEY

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000 CATEGORY B TREE + TREE REF.

000 CATEGORY C TREE + TREE REF.

000 CATEGORY U TREE + TREE REF.

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W1 WOODLAND GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)

ROOT PROTECTION AREA

REFER TO GROUP G110

BUILDING ZONES

NON-MANDATORY TREE TO BE RETAINED WHERE POSSIBLE

NON-MANDATORY TREE GROUP TO BE RETAINED WHERE POSSIBLE

5M BUFFER FROM TREE STEM TO BUILDING EDGE

8M BUFFER FROM TREE STEM TO BUILDING EDGE

10M BUFFER FROM TREE STEM TO BUILDING EDGE

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Title: TREE PROTECTION PLAN SHEET 3

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A1	1:500	BC Date 07/02/17	TD Date 07/02/17	TD Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_03	E

TREE PROTECTION KEY

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000	CATEGORY B TREE + TREE REF.
000	CATEGORY C TREE + TREE REF.
000	CATEGORY U TREE + TREE REF.
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	ROOT PROTECTION AREA
	REFER TO GROUP G110
	BUILDING ZONES
	NON-MANDATORY TREE TO BE RETAINED WHERE POSSIBLE
	NON-MANDATORY TREE GROUP TO BE RETAINED WHERE POSSIBLE
	5M BUFFER FROM TREE STEM TO BUILDING EDGE
	8M BUFFER FROM TREE STEM TO BUILDING EDGE
	10M BUFFER FROM TREE STEM TO BUILDING EDGE
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A1	1:500	BC Date 07/02/17	TD Date 07/02/17	TD Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_04	E

TREE PROTECTION KEY

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000 CATEGORY B TREE + TREE REF.

000 CATEGORY C TREE + TREE REF.

000 CATEGORY U TREE + TREE REF.

G1 TREE GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)

W1 WOODLAND GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)

ROOT PROTECTION AREA

REFER TO GROUP G110

BUILDING ZONES

NON-MANDATORY TREE TO BE RETAINED WHERE POSSIBLE

NON-MANDATORY TREE GROUP TO BE RETAINED WHERE POSSIBLE

5M BUFFER FROM TREE STEM TO BUILDING EDGE

8M BUFFER FROM TREE STEM TO BUILDING EDGE

10M BUFFER FROM TREE STEM TO BUILDING EDGE

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A1	1:500	BC, Date 07/02/17	TD, Date 07/02/17	TD, Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_05	E

TREE PROTECTION KEY

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000 CATEGORY B TREE + TREE REF.
000 CATEGORY C TREE + TREE REF.
000 CATEGORY U TREE + TREE REF.

G1 TREE GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)

W1 WOODLAND GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)

ROOT PROTECTION AREA

REFER TO GROUP G110

BUILDING ZONES

NON-MANDATORY TREE TO BE RETAINED WHERE POSSIBLE

NON-MANDATORY TREE GROUP TO BE RETAINED WHERE POSSIBLE

5M BUFFER FROM TREE STEM TO BUILDING EDGE

8M BUFFER FROM TREE STEM TO BUILDING EDGE

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Status	Drawing Number	Rev
P	5137998_COL_ARB_06	E

TREE PROTECTION KEY

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- 000 CATEGORY B TREE + TREE REF.
- 000 CATEGORY C TREE + TREE REF.
- 000 CATEGORY U TREE + TREE REF.
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- ROOT PROTECTION AREA
- REFER TO GROUP G110
- BUILDING ZONES
- NON-MANDATORY TREE TO BE RETAINED WHERE POSSIBLE
- NON-MANDATORY TREE GROUP TO BE RETAINED WHERE POSSIBLE
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Project: WEST CAMBRIDGE MASTERPLAN (EIA)

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A1	1:500	BC, Date 07/02/17	TD, Date 07/02/17	TD, Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_07	E

TREE PROTECTION KEY

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- 000 CATEGORY B TREE + TREE REF.
- 000 CATEGORY C TREE + TREE REF.
- 000 CATEGORY U TREE + TREE REF.
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Title: TREE PROTECTION PLAN SHEET 8

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A1	1:500	BC Date 07/02/17	TD Date 07/02/17	TD Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_08	E

TREE PROTECTION KEY

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- 000 CATEGORY B TREE + TREE REF.
- 000 CATEGORY C TREE + TREE REF.
- 000 CATEGORY U TREE + TREE REF.
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Title: TREE PROTECTION PLAN SHEET 9

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A1	1:500	BC Date 07/02/17	TD Date 07/02/17	TD Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_09	E

TREE PROTECTION KEY

000 CATEGORY A TREE + TREE REF.
000 CATEGORY B TREE + TREE REF.
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000 CATEGORY U TREE + TREE REF.

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W1 WOODLAND GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)

ROOT PROTECTION AREA

REFER TO GROUP G110

BUILDING ZONES

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NON-MANDATORY TREE GROUP TO BE RETAINED WHERE POSSIBLE

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Title: TREE PROTECTION PLAN SHEET 10

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A1	1:500	BC Date 07/02/17	TD Date 07/02/17	TD Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_10	E

TREE PROTECTION KEY

- 000 CATEGORY A TREE + TREE REF.
- 000 CATEGORY B TREE + TREE REF.
- 000 CATEGORY C TREE + TREE REF.
- 000 CATEGORY U TREE + TREE REF.
- G1 TREE GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)
- W1 WOODLAND GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)
- ROOT PROTECTION AREA
- REFER TO GROUP G110
- BUILDING ZONES
- NON-MANDATORY TREE TO BE RETAINED WHERE POSSIBLE
- NON-MANDATORY TREE GROUP TO BE RETAINED WHERE POSSIBLE
- 5M BUFFER FROM TREE STEM TO BUILDING EDGE
- 8M BUFFER FROM TREE STEM TO BUILDING EDGE
- 10M BUFFER FROM TREE STEM TO BUILDING EDGE
- 15M BUFFER FROM TREE STEM TO BUILDING EDGE

Stat	Purpose of Issue	Date	Auth
P	PLANNING	12/04/16	TD

Rev	Description	By	Date	Chk'd	Auth
E	MINOR AMENDMENT TO KEY	BC	13/06/17	TD	TD
D	AMENDMENT OF TREES SHOWN TO BE REMOVED	BC	12/05/17	TD	TD
C	VARIOUS AMENDMENTS	BC	26/04/17	TD	TD
B	AMENDED DEVELOPMENT ZONES	AA	07/02/17	TD	TD
A	RETENTION OF TREE GROUP G064	BC	17/05/16	TD	TD
–	ORIGINAL PLANNING ISSUE	BC	12/04/16	TD	TD

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Client: UNIVERSITY OF CAMBRIDGE

Title: TREE PROTECTION PLAN SHEET 11

Project: WEST CAMBRIDGE MASTERPLAN (EIA)

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A1	1:500	BC, Date 07/02/17	TD, Date 07/02/17	TD, Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_11	E

TREE PROTECTION KEY

- 000 CATEGORY A TREE + TREE REF.
- 000 CATEGORY B TREE + TREE REF.
- 000 CATEGORY C TREE + TREE REF.
- 000 CATEGORY U TREE + TREE REF.
- G1 TREE GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)
- W1 WOODLAND GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)
- ROOT PROTECTION AREA
- REFER TO GROUP G110
- BUILDING ZONES
- NON-MANDATORY TREE TO BE RETAINED WHERE POSSIBLE
- NON-MANDATORY TREE GROUP TO BE RETAINED WHERE POSSIBLE
- 5M BUFFER FROM TREE STEM TO BUILDING EDGE
- 8M BUFFER FROM TREE STEM TO BUILDING EDGE
- 10M BUFFER FROM TREE STEM TO BUILDING EDGE
- 15M BUFFER FROM TREE STEM TO BUILDING EDGE

Stat	Purpose of Issue	Date	Auth
P	PLANNING	12/04/16	TD

Rev	Description	By	Date	Chk'd	Auth
E	MINOR AMENDMENT TO KEY	BC	13/06/17	TD	TD
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B	AMENDED DEVELOPMENT ZONES	AA	07/02/17	TD	TD
A	RETENTION OF TREE GROUP G064	BC	17/05/16	TD	TD
–	ORIGINAL PLANNING ISSUE	BC	12/04/16	TD	TD

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Project: WEST CAMBRIDGE MASTERPLAN (EIA)

Title: TREE PROTECTION PLAN
SHEET 12

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A1	1:500	BC, Date 07/02/17	TD, Date 07/02/17	TD, Date 07/02/17

Status	Drawing Number	Rev
P	5137998_COL_ARB_12	E

15.5.3 Whilst the proposed Western Access Road junction would operate within capacity with the 2031 Do Something flows, it is considered that the first-principles Transport Modelling assessment adopted for this development would represent a worst case, as the methodology adopted does not assess likely reassignment effects across the network, and mitigation measures provided by others have not been considered within the assessment.

15.5.4 A solution for the Madingley Road Corridor delivered by providing significant levels of additional capacity is undesirable as:

i) these additional flows have been assessed without reference to the link and junction capacity of the network - hence these increases may be considered to be worst case, and not necessarily achievable;

ii) it would require significant additional infrastructure;

iii) to increase the physical scale of the Madingley Road carriageway would be contrary to any enhanced urban design aspirations for this area; and

iv) it would result in a poorer environment for pedestrians and cyclists.

15.5.5 As such, it is concluded that the strategy to respond to these junction capacity issues along Madingley Road Corridor should rely upon strategic solutions, within the context of the existing local transport policy identified within Section 4.

15.5.6 Similarly, although the Madingley Mulch Roundabout is predicted to operate marginally above capacity, within the context of the other proposals for this area it is concluded that no physical works be undertaken.

PART 4 TRAVEL MANAGEMENT MEASURES

Part 4 of the Transport Assessment contains Sections 16 - 18:

16 Travel Management Measures Overview

16.1 Introduction

16.1.1 This section of the report summarises the proposed measures to manage any transport effects of the Proposed Development above that of the Consented Development in a phased manner. The following scenarios are considered in greater detail in the following sections:

i) the 2021 Initial Phase of Development – Section 17; and

ii) the 2031 Full Development – Section 18.

16.1.2 The West Cambridge Do Something option tests have been run incorporating the benefit of the Development Travel Demand Management Strategy summarised in Section 9 - incorporating the proposed public transport, pedestrian and cycle strategy, and the controlled car parking provision.

16.2 2021 Initial Phase of Development

16.2.1 Section 14 considers in detail the most likely outcome of the Initial Phase of Development in 2021 in terms of trip generation and traffic impact in the context of current and planned conditions. The results from this 2021 Do Something assessment identified there is a minor residual impact on Madingley Road when compared to the Consented situation.

16.2.2 Section 17 therefore identifies an appropriate transport strategy to manage the likely transport effects from the Initial Phase of Development.

16.3 2031 Full Development

16.3.1 Section 15 reports the outcome of the Full Development in 2031 in terms of trip generation and traffic impact in the context of current and planned conditions.

16.3.2 As discussed with the Joint Authorities, an Adaptive Phased Approach has been adopted, reflecting the context of considerable planning and infrastructure uncertainty, including:

i) the Cambridge Local Plan still being the subject of an Inquiry;

ii) the changes in the highway network conditions as a consequence of the A14 Huntingdon – Cambridge Improvement Scheme, granted a Development Consent Order by the Secretary of State in May 2016;

iii) the on-going deliberations surrounding the Greater Cambridge City Deal strategy – which could include significant transport mitigation as well as deterrence measures such as work-place charging, and peak-hour travel restrictions;

iv) the timing of the delivery of elements of the Cambridgeshire Cambridge Long-Term Transport Strategy;

v) Highways England’s consideration of measures along the M11; and

vi) the impact of a series of other transport schemes – including the Oxford – Cambridge Expressway, and East-West Rail.

16.3.3 All of these would have a significant and substantial effect upon strategic movement across the region, and would influence the future access and movement strategy of West Cambridge – particularly in the mid- to late phases of the Development. These impacts are compounded by the degree of variability in future projections (which can be attributed to a number of factors including fuel prices, Government policy etc).

16.3.4 For the purposes of deriving an appropriate strategy for managing the impacts of West Cambridge - which would then be used to assess the necessary Adaptive Phased Approach Transport Cap - a pragmatic and strategic management strategy has been formulated for West Cambridge. This strategy would:

i) encourage greater use of public transport;

ii) control and reduce vehicular trips across the network;

iii) where necessary, provide measures to preserve and / or enhance capacity on particular links;

iv) manage Development impact on some sensitive strategic links; and

v) improve pedestrian and cyclist movement across the network.

16.3.5 Whilst this Strategy, reported in Section 18 is designed to manage the Development impact, it also provides the Joint Authorities the most flexibility in focussing the available finances in the future into the most beneficial measures to deliver real travel pattern change.

16.4 Management Strategy

16.4.1 Sections 17 and 18 provide further information about the management measures for each scenario.

16.4.2 These sections conclude that the overall effects of the proposed travel demand measures would:

i) control the number of vehicle movements;

ii) offset any additional non-car mode trips generated by the Proposed Development; and

iii) provide sufficient financial support for a flexible management solution to manage demand from the Full Development within the context of significant planning and infrastructure uncertainty.

16.4.3 The Development proposals, and required transport management identified in this Transport Assessment, are independent of the emerging City Deal proposals, and will adequately mitigate the envisaged transport impact of the Development. As such, the West Cambridge outline planning application does not rely on the City Deal proposals for mitigation. If the City Deal measures do come forward and supersede any of the mitigation proposed by the University, it is expected that relevant agreed levels of contribution for specific mitigation identified herein could be reallocated (with the University and County's agreement) to support these City Deal measures.

17 The 2021 Transport Strategy

17.1 Introduction

17.1.1 Whilst the traffic impact of the Initial Phase of West Cambridge compared to that consented is limited, a transport strategy has been developed for 2021, the early phase of development. This transport strategy, compatible with the strategy for the Full Development, would increase accessibility to the site by all modes.

17.2 Summary of the transport management strategy

17.2.1 This section provides a summary of the transport management measures within the Initial Phase, the details are contained in Appendix 17.1.

17.2.2 These measures were formulated in order to:

i) decrease the journey to work trip distance across the Cambridge area by providing employment land-use within the City complementary to the existing and future residential land-uses;

ii) taking advantage of the conveniently located facilities on North West Cambridge – the retail, the primary education and the community facilities - that would reduce the need to travel elsewhere during the working day;

iii) provide regular bus services to popular destinations to provide for as many longer distance movements as possible – such as the residential areas around the north and west areas of Cambridge and the new Chesterton Rail Station, Cambridge Rail Station, and the University's facilities across town;

iv) reduce and control the total vehicular trip generation associated with the Development.

17.2.3 As detailed in Section 12, the Initial Phase 2021 West Cambridge Do Something option test modelling already incorporates the benefit of the proposed West Cambridge travel demand management strategy (summarised in Section 9). The measures inherent in that assessment include:

i) the new residential offer in the area - the new market housing being provided at Darwin Green (to the north of Huntingdon Road); as well as the additional units at the North West Cambridge Development, located immediately to the north of Madingley Road – with student accommodation, market housing, and Key Worker housing for University staff;

ii) the proposed walking and cycling facilities;

iii) the Framework Travel Plan (see separate document); and

iv) the proposed public transport strategy summarised in Section 7.

17.2.4 The 2021 Transport Management Strategy is shown indicatively on Figure 17.1, and summarised in Table 17.1. It identifies a range of proposed measures to manage the development:

Table 17.1 – Summary of 2021 Transport Management Measures

Transport Objective:	Measure:
To control and reduce vehicle trip generation:	• provision of appropriate levels of car parking on-site; • managing car parking provision on-site; • management of car parking off-site.
To preserve conditions:	• contributions to implement the reduced Madingley Road speed limit; • promote three local road safety schemes.
To improve conditions for pedestrians and cyclists on-site:	• quality footway / cycleway infrastructure; • high levels of conveniently located quality cycle parking; • all major occupiers providing shower and changing room facilities; • managing cycle parking provision.
To improve conditions for pedestrians and cyclists off-site:	• providing remedial measures to assist in resolving existing road safety issues on two adjacent junctions, disproportionally affecting cyclists • improved crossing at Observatory Drive; • new Cycling Zebra on Madingley Road; • improved facilities along the Corridor to the City Centre – along Coton Path, Adams Road and Burrell's Walk; • contributions to the implementation of the reduced Madingley Road speed limit.
To enhance Public Transport on-site:	• provision of high quality bus stops; • provide selected vehicle detection for buses through any traffic signal controlled junctions to provide bus priority; and • provide information and incentives to the site occupiers.
Enhanced bus services:	• Citi 4 - to be diverted into West Cambridge to provide links to the city centre and the A428 corridor; • Universal – increased frequency, potentially to every 10 minutes, and operation extended to Saturdays; and • Arc Service – operation of a new hourly orbital service from West Cambridge via North West Cambridge, Darwin Green and the Science Park to Milton Park and Ride.
Enhancing travel demand management	• locate further Car Club vehicles on-site; • improve access to local car sharing data bases; • consider cycling initiatives – including cycle pools, cycle buddy, training, discounted equipment; • marketing and promotion.
To preserve highway capacity, consider physical interventions	• acknowledging the assessment is worse case and does not include for the benefit from the transport solutions proposed by other developments, provide cyclic counting to monitor future conditions; • provide limited mitigations at the Madingley Road / High Cross junction if required to mitigate West Cambridge impacts.

17.3 Summary

17.3.1 This Section summarises the proposed measures to manage any residual transport impacts of the Initial Phase of Development in 2021. It highlights that the University has developed a range of measures to manage the effects of the Initial Phase of development on the transport network, varying from “softer” to physical infrastructure improvements.

17.3.2 The Madingley Road Corridor assessment identifies that these junctions would work within capacity should the benefit of transport strategies to be provided by others be achieved. A physical solution has been prepared which could respond to the worst case assessment of flows, but it is concluded that this would be unnecessary.

17.3.3 It is concluded that this suite of measures aimed at mode shift, demand management and improvement of conditions on the network would manage the transport effects of the Initial Phase of Development.

18 The 2031 Transport Strategy

18.1 Introduction

18.1.1 This section provides information about the additional management measures to accommodate the Full Development of West Cambridge.

18.1.2 Transport measures have been identified to support the 2031 Full Development. These measures have primarily been identified to inform the assessment of the Transport Cap, needed to finance the necessary development mitigation.

18.2 The area-wide Strategic context

18.2.1 West Cambridge would be implemented within the context of the delivery of the Cambridge and South Cambridgeshire Local Plan expansion – further details are provided in Section 2.

18.2.2 The Transport Strategy for Cambridge / South Cambridgeshire identified that this area would have significant growth in jobs and population in the period between 2013 and 2031. Around 35,000 new dwellings will be built in and around the city, and 44,000 jobs are expected to be created at various sites, including those at the allocated West Cambridge development. It identifies that the transport network to support this growth would need to provide capacity to allow for the additional transport demands of new residents and workers, whilst protecting the area’s distinctive character and environment.

18.2.3 To achieve this, sustainable transport capacity would need to be provided and enhanced in the city region between key economic hubs in and around the city, and to where people live and access services. The sustainable transport network will strengthen the links between employment hubs and high-tech clusters in Cambridge and South Cambridgeshire, and in the surrounding towns, by making movement between them straightforward and convenient. It identifies the need for:

i) a high quality passenger transport network of bus, guided bus and rail services;

ii) comprehensive pedestrian and cycle networks; and

iii) highways capacity enhancements to ensure that traffic can move efficiently in appropriate locations without interfering with passenger transport corridor in Cambridge and its fringes; and

iv) investment will be required to transform movement along corridors, by filling key gaps in the network and introducing high quality facilities.

18.2.4 The Cambridge Sub Regional Transport Model (CSRM) was used to model the transport impacts of development strategy options and the preferred strategy for the Cambridge and South Cambridgeshire Local Plans. The proposed submission Local Plans scenarios were tested together with a package of transport measures developed with CCC. CCC concluded that these measures would prove successful in managing demand for car based travel and increasing use of sustainable modes such that any increase in average delay across the network would be minimal. As the densification of West Cambridge was included within the Local Plan as an allocated site, West Cambridge would have been tested within the Local Plan Transport Study work. As such, the necessary infrastructure to facilitate the development would have already been identified within the Transport Strategy.

18.2.5 As well as the transport measures promoted by CCC to accommodate the Local Plan growth, there are further more strategic transport interventions being promoted which will have an influence on the transport network, including:

i) the A14 Huntingdon – Cambridge Improvement Scheme;

ii) the A428 Black Cat to Caxton Gibbet Enhancement Scheme;

iii) Highways England's consideration of measures along the M11; and

iv) the impact of a series of other transport schemes – including - inter alia - the Oxford – Cambridge Expressway, and East-West Rail.

18.2.6 All of these would have a significant and substantial effect upon strategic movement across the region, and would influence the future access and movement strategy of West Cambridge – particularly in the mid- to late phases of the Development. These impacts are compounded by the degree of variability in future projections (which can be attributed to a number of factors including fuel prices, Government policy etc).

18.2.7 As the outline planning application will be submitted prior to the detailed definition of these measures, as agreed with the Joint Authorities (Cambridge City Council – the planning authority, Cambridgeshire County Council – the local highway authority, and Highways England – the strategic highway authority), an Adaptive Phased Approach has been adopted, incorporating:

- a graduated approach – the assessment process reflecting current transport planning policy where travel demand management measures are introduced first, followed by any necessary highway infrastructure measures to mitigate the residual traffic impact; as well as

- an adaptive approach – where, to maintain future flexibility, the proposed mitigation for later phases responds to the quanta of development within the individual phased proposals, the timescales for the delivery, changes in future travel behaviour patterns, emerging transport policy, and the current uncertainty relating to the area-wide transport enhancement proposals delivered by others.

18.2.8 For the purposes of deriving an appropriate strategy for managing the impacts of West Cambridge - which would then be used to assess the necessary Adaptive Phased Approach Transport Cap - a pragmatic and strategic management strategy has been formulated for West Cambridge. This strategy would:

i) encourage greater use of public transport;

ii) control and reduce vehicular trips across the network;

iii) where necessary, provide measures to preserve and / or enhance capacity on particular links;

iv) manage Development impact on some sensitive strategic links; and

v) improve pedestrian and cyclist movement across the network.

18.2.9 The funding made available by the Adaptive Phased Approach could therefore be better focussed to where support is required, and would be used to support the delivery of schemes more effective in resolving local issues.

18.3 Summary of the transport management strategy

18.3.1 This section provides a summary of the transport management measures to mitigate the Full Development in 2031, building upon the earlier 2021 strategy, the details are contained in Appendix 18.1.

18.3.2 As detailed in Section 15, the 2031 West Cambridge Do Something option test modelling already incorporates the benefit of the proposed Development travel demand management strategy (summarised in Section 9). The measures inherent in that assessment include:

i) the new residential offer in the area - the new market housing being provided at Darwin Green (to the north of Huntingdon Road); as well as the additional units at the North West Cambridge Development, located immediately to the north of Madingley Road – with student accommodation, market housing, and Key Worker housing for University staff;

ii) the continuing delivery of the Framework Travel Plan (see separate document);

iii) the later elements of the phased public transport strategy summarised in Section 7. Particularly, this relates specifically to the Arc service providing regular connections between the Milton Park and Ride, and West Cambridge.

18.3.3 Any mitigation strategy for West Cambridge in 2031 has to be considered within the context of the Section 106 highway mitigation measures already delivered by the University for the Extant West Cambridge Development – as identified in Section 2.3 - and the likely 2031 flows identified in Section 13. This identifies that mitigation has already been provided for around 13% of the additional movements generated between the 2031 Do Minimum and Do Something scenarios.

18.3.4 West Cambridge forms a relatively small part of the emerging Cambridge Local Plan allocation, for which the Joint Authorities have developed strategic transport solutions to accommodate these movements. A coherent transport strategy for West Cambridge has to be considered within this context. West Cambridge cannot be expected to resolve these major issues independently, albeit that the University will assist in delivering part of this solution – for example, offering to accommodate a quality public transport corridor through West Cambridge to assist in an economic delivery of the A428 / A1303 Corridor Enhancement.

18.3.5 The worst case assessment of the West Cambridge development-generated 2031 flow impact reported in Section 15 identifies additional movements focussed on the following five corridors:

Table 18.1 – Additional traffic movements to West Cambridge

Corridor	AM / PM peak hour two-way flow	Most direct route into West Cambridge
A14 (North-West)	200 / 170	via Huntingdon Road and North West Cambridge
A14 (East) and A10 (North)	120 / 110	via Histon Road, Lady Margaret Road and Madingley Road (East)
East of Cambridge	100 / 40	via Grange Road and Madingley Road (East)
M11 (South)	190 / 190	via M11 Junction 13
A428 (West)	85 / 75	via Madingley Road and M11 Junction 13

18.3.6 To manage the potential additional vehicle movements along these Corridors, the University will work together with the Joint Authorities to deliver the following strategic solutions identified within the Cambridge Long-Term Transport Strategy:

Table 18.2 – Strategic management measures

Corridor	Measures
A14 (North-West)	Improved signage of existing Park and Ride sites along the A14, extension of Guided Busway services
A14 (East) and A10 (North)	Increase use of the existing Milton Park and Ride site, promotion of the new radial Arc bus services
East of Cambridge and M11 (South)	Promotion of extended Orbital / Arc bus services to serve the future Barton Road Park and Ride site
A428 (West)	Development of the Madingley Mulch Park and Ride site, promotion of the new A428 / A1303 Corridor bus services

18.3.7 These strategic solutions would form part of the 2031 Transport Management Strategy. The potential measures that could form part of the Transport Management Solution are shown on Figure 18.1, and are summarised in Table 18.3:

Table 18.3 – Summary of 2031 Transport Management Measures

Transport Objective:	Measure:
To control and reduce vehicle trip generation:	• provision of appropriate levels of car parking on-site, with delivery phased to reflect development implementation; • managing the on-site car parking provision; • continue benefit of earlier off-site parking control measures.
To preserve conditions:	• offer contributions to the delivery of an extension of the speed limit along Madingley Road to reflect the new junction arrangements.
To improve conditions for pedestrians and cyclists on-site:	• quality footway / cycleway infrastructure; • high levels of conveniently located quality cycle parking; • all major occupiers providing shower and changing room facilities; • managing cycle parking provision.
To improve conditions for pedestrians and cyclists off-site:	• improved crossing at Eddington Avenue; • improved facilities along the Corridor to the City Centre – along Grange Road, West Road, Queen's Green and Silver Street; • offer contributions to the delivery of an extension of the speed limit along Madingley Road to reflect the new junction arrangements.
To enhance Public Transport on-site:	• provide selected vehicle detection for buses through traffic signal controlled junctions to provide bus priority; and • provide information and incentives to the site occupiers.
Enhanced bus services:	• Citi 4 - increased frequency to every 10 minutes; • Universal – possibly introduce an extended orbital service to Addenbrooke's Hospital; or • Arc Service – increased frequency, and possibly extend service further to the potential Barton Road Park and Ride and towards South Cambridge;

Transport Objective:	Measure:
Enhanced bus services (Cont'd):	• review a new variation of the Service B on the Guided Busway.
Enhancing travel demand management:	• locate further Car Club vehicles on-site; • review cycling initiatives – including cycle pools, cycle buddy, training, discounted equipment; • marketing and promotion.
To preserve local highway capacity, consider physical interventions:	• provide localised highway enhancement to accommodate the new Western Access Road junction; • consider further highway mitigations, if required.
To preserve strategic highway capacity, consider Corridor interventions:	• work together with the Highway and Planning Authorities to deliver interventions strategically

18.4 Summary

18.4.1 This Section summarises the proposed measures needed to support the 2031 Full Development. This strategy has been provided primarily to inform the assessment of the Transport Cap, needed to finance the necessary development mitigation.

18.4.2 It is concluded that this suite of measures aimed at mode shift, demand management and improvement of conditions on the network would manage the transport effects of the Development.

18.4.3 A strategy to manage these worst case increased movements along Madingley Road by physical measures has not been considered:

i) it would require significant additional infrastructure;

ii) to increase the physical scale of the Madingley Road carriageway would be contrary to any enhanced urban design aspirations for this area;

iii) it would result in a poorer environment for pedestrians and cyclists.

PART 5 CONCLUSIONS

Part 5 of the Transport Assessment contains the Conclusions

19 Conclusions

19.1 This report sets out the results of the Transport Assessment undertaken to accompany the application for outline planning permission by the University of Cambridge develop land at West Cambridge.

19.2 An existing masterplan for West Cambridge was granted an approval in 1999, and this consent forms the basis of the current development on the Site. This consent envisaged 248,272m^2 of development - of academic, research institute and commercial research, as well as ancillary use shared facilities, sports, and residential uses.

19.3 The Cambridge Local Plan 2014: Proposed Submission Policy 18 promotes the densification of the existing West Cambridge through a revised masterplan, subject to a number of conditions. It is within this context that the University of Cambridge has produced a new masterplan for the Site which significantly increases the amount of development to approximately 500,280m^2.

19.4 The University already has a proud reputation throughout the City for promoting its travel demand management strategy, and has always been proactive in delivering improvements to it. This philosophy will be continued at West Cambridge.

19.5 The Development accords well with national transport policy and guidance to deliver sustainable development:

i) its sustainable location within Cambridge, and the incorporation of employment well located adjacent to residential land-uses reducing the need to travel - supporting the stated aspirations and objectives of paragraph 34 of the National Planning Policy Framework; and

ii) by promoting ways to reduce the traffic impact of this development and the University's other activities within Cambridge, and by "managing down" traffic generation, the Development supports the policy of the Department for Transport's Circular 02/2013.

19.6 The Development also accords with important local transport and planning policy requirements:

i) of Policy 18 of the Cambridge Local Plan - by including a comprehensive transport strategy for the site, incorporating a sustainable transport plan to minimise reliance on private cars, as well as enhancing links for walking, cycling and public transport (including access for all) to the city centre, railway station(s), other principal educational and employment sites, and other key locations within the city to support sustainable development;

ii) by improving the local footpath and cycleway network as an integral part of a wider transport system – thus improving access to the surrounding countryside – according with the Cambridgeshire Rights of Way Improvement Plan; and

iii) of the measures identified within the Cambridge Long-Term Transport Strategy, the public transport strategy would deliver enhanced public transport services.

19.7 West Cambridge is being brought forward within the context of wide-reaching planning uncertainty – including:

i) the Cambridge Local Plan still being the subject of an Inquiry;

ii) the changes in the highway network conditions as a consequence of the A14 Huntingdon – Cambridge Improvement Scheme, granted a Development Consent Order by the Secretary of State in May 2016;

iii) the deliberations and a decision surrounding the Greater Cambridge City Deal strategy – which could include significant transport mitigation as well as deterrence measures such as work-place charging, and peak-hour travel restrictions;

iv) the timing of the delivery of elements of the Cambridgeshire Cambridge Long-Term Transport Strategy;

v) Highways England's consideration of measures along the M11; and

vi) the impact of a series of other transport schemes – including the Oxford – Cambridge Expressway, and East-West Rail.

19.8 These would have a significant and substantial effect upon the strategic movements of vehicles across the region, and influence the future access and movement strategy of West Cambridge – particularly in the mid- to late phases of the Development.

19.9 As the outline planning application will be submitted prior to the detailed definition of these measures, as discussed with the Joint Authorities (Cambridge City Council – the planning authority, Cambridgeshire County Council – the local highway authority, and Highways England – the strategic highway authority), an Adaptive Phased Approach has been adopted, incorporating:

i) a graduated approach – the assessment process reflecting current transport planning policy where travel demand management measures are introduced first, followed by any necessary highway infrastructure measures to mitigate the residual traffic impact; as well as

ii) an adaptive approach – where, to maintain future flexibility, the proposed mitigation for later phases responds to the quanta of development within the individual phase proposals, the timescales for the delivery, changes in future travel behaviour patterns, emerging transport policy, and the current uncertainty relating to the area-wide transport enhancement proposals delivered by others.

19.10 As such, this Transport Assessment provides a detailed assessment of the trip generation of an indicative Initial Phase of development only, relating to the 2021 scenario, and the associated mitigation strategy. The vehicular trip generation from West Cambridge is compared against that arising from the Extant Consent for this site, and shown to be lower.

19.11 Further information relating to the traffic impact, highway capacity assessment and mitigation relating to later phases of West Cambridge (i.e., for 2021 onwards) will be provided subsequently in the context of further clarity being reached.

19.12 Within the context of an assessment of an Initial Phase of development in 2021 with relatively small development impact, it was agreed that a more local approach to the assessment of impact was appropriate. A methodology was therefore agreed with the Joint Authorities, based upon Peter Brett Associates' Transport Modelling.

19.13 The results from the 2021 modelling show:

i) the original assessment of vehicle trip generation of the original 1997 West Cambridge application – and upon which the delivered highway mitigation strategy was derived - is 7% higher than the equivalent Do Minimum assessment derived from Peter Brett Associates' analysis; and

iii) the reduction in car parking provision within the Do Something Initial Phase of Development proposals results in a reduced trip generation from West Cambridge.

19.14 As such, when compared to the 2016 Base flows, the percentage increases in link flows for the 2021 Do Something Development will be less than for the 2021 Do Minimum scenario.

19.15 The 2021 traffic impact assessment concluded that:

i) the differences between the 2016 Base Year and 2021 Do Minimum scenarios (i.e., With the Consented Development) indicate that the network will experience significant increases in peak hour flows;

ii) the differences between the 2021 Do Minimum and 2021 Do Something scenarios (i.e., the impact of the Proposed Development) would be minimal. There are only a limited number of links that experience flow increases locally, mainly due to the proposed Development car parking access strategy;

iii) the 2021 junction capacity assessment identified that the Madingley Road Corridor would operate over capacity without the additional trips from the Proposed Development. Whilst an enhancement solution has been identified, it is responding to a worst case assessment - one that is unrealistic. Whilst a proposed cyclic survey has been proposed to monitor this situation – and implement measures if agreed to be necessary - the proposed strategy including for enhanced non-car modes is considered more appropriate.

19.16 The comparison between the 2016 and 2031 Do Minimum model peak hour flows (i.e., the impact of the background growth on the network without any of the additional trips generated by the Proposed Development) identifies that all links experience increases in the peak hour flows, reflecting the additional flow generated by the Local Plan allocation sites.

19.17 As there may be a degree of variability in future projections (which can be attributed to a number of factors including fuel prices, Government policy etc), a pragmatic management strategy has been formulated for West Cambridge which is compatible with the strategic solutions identified within the Cambridge Long-Term Transport Strategy, and is resilient to change. This strategy would:

i) control vehicular trips across the network;

ii) where demonstrated to be necessary, provide physical measures to preserve and / or enhance capacity on particular links;

iii) manage Development impact on some sensitive strategic links; and

iv) improve pedestrian and cyclist movement across the network.

19.18 Whilst the proposed Western Access Road junction would operate within capacity with the worst case assessment of 2031 Do Something flows, the proposed transport strategy is to respond to these junction capacity issues along Madingley Road Corridor by relying upon strategic solutions, within the context of the existing local transport policy.

19.19 In summary:

i) the Development accords well with national and local transport policy;

ii) the Development also accords with important local transport and planning policy requirements:

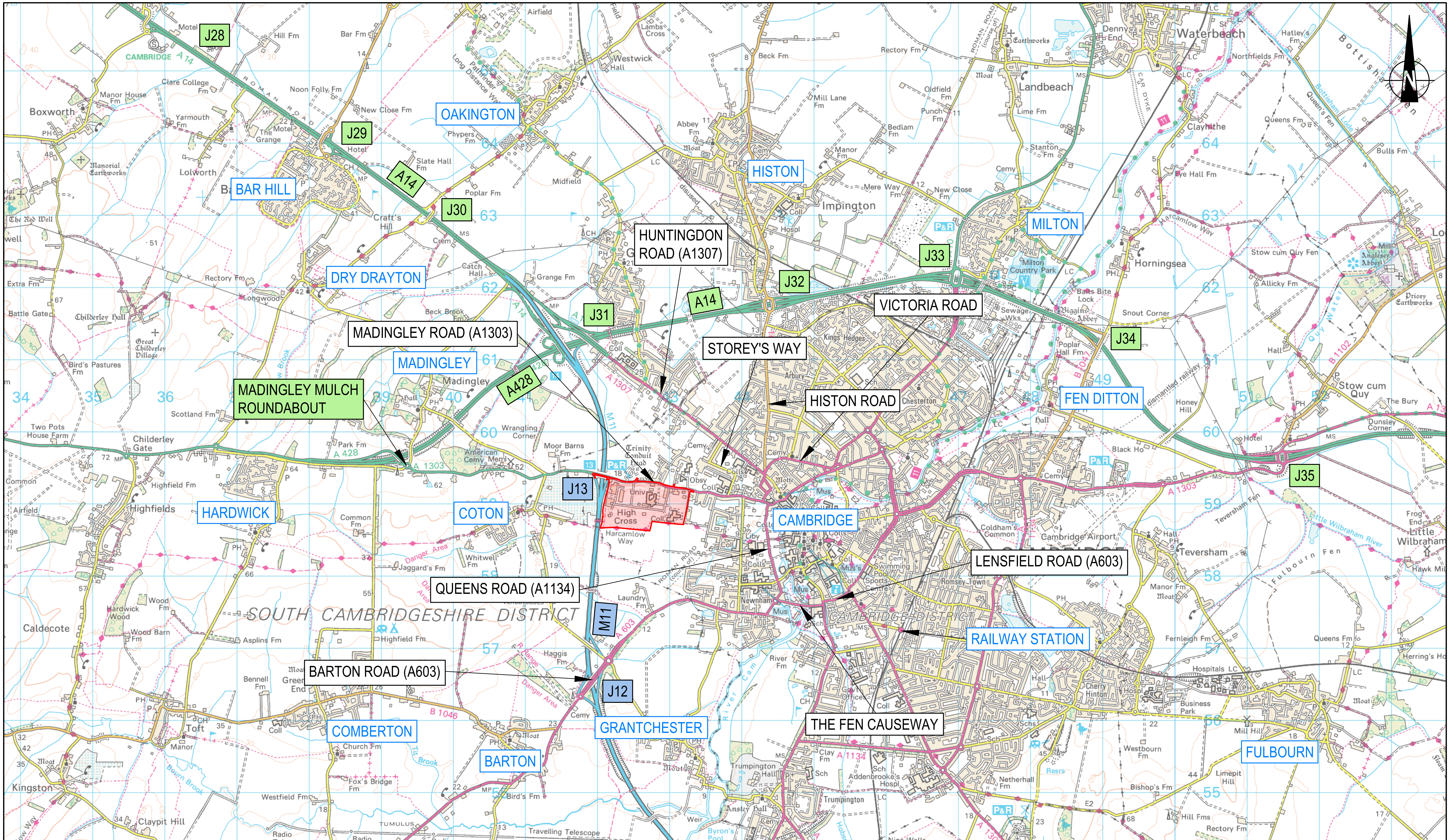
iii) as the outline planning application will be submitted in the context of uncertainty relating to local development and infrastructure mitigation, that the adopted Adaptive Phased Approach provides a robust and reasonable manner of assessment, in a flexible manner;

iv) that a detailed assessment of the vehicular trip generation of an indicative Initial Phase of development shows that when compared to the traffic impact of the consented – and mitigated – West Cambridge Development, that the impact of the Development proposals is minimal;

v) as there may be a degree of variability in future projections (which can be attributed to a number of factors including fuel prices, Government policy etc), the traffic management strategy formulated for West Cambridge is pragmatic, and is designed to be resilient to change; and

vi) the overall transport strategy for the Development responds to a number of important national regional and local objectives.

19.20 As such, there are no transport-based reasons why planning consent should not be granted for the West Cambridge Development.



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WEST CAMBRIDGE DEVELOPMENT

STRATEGIC SITE LOCATION PLAN

Mark	Revision	Date	Drawn	Chkd	Appd

Drawing Status
TRANSPORT ASSESSMENT

Date of 1st Issue	SEP 2017		
A3 Scale	NTS		
Design		Drawn	DS
Chkd	JH	Appd	JH

Drawing Number: FIGURE 2.1
Revision: -

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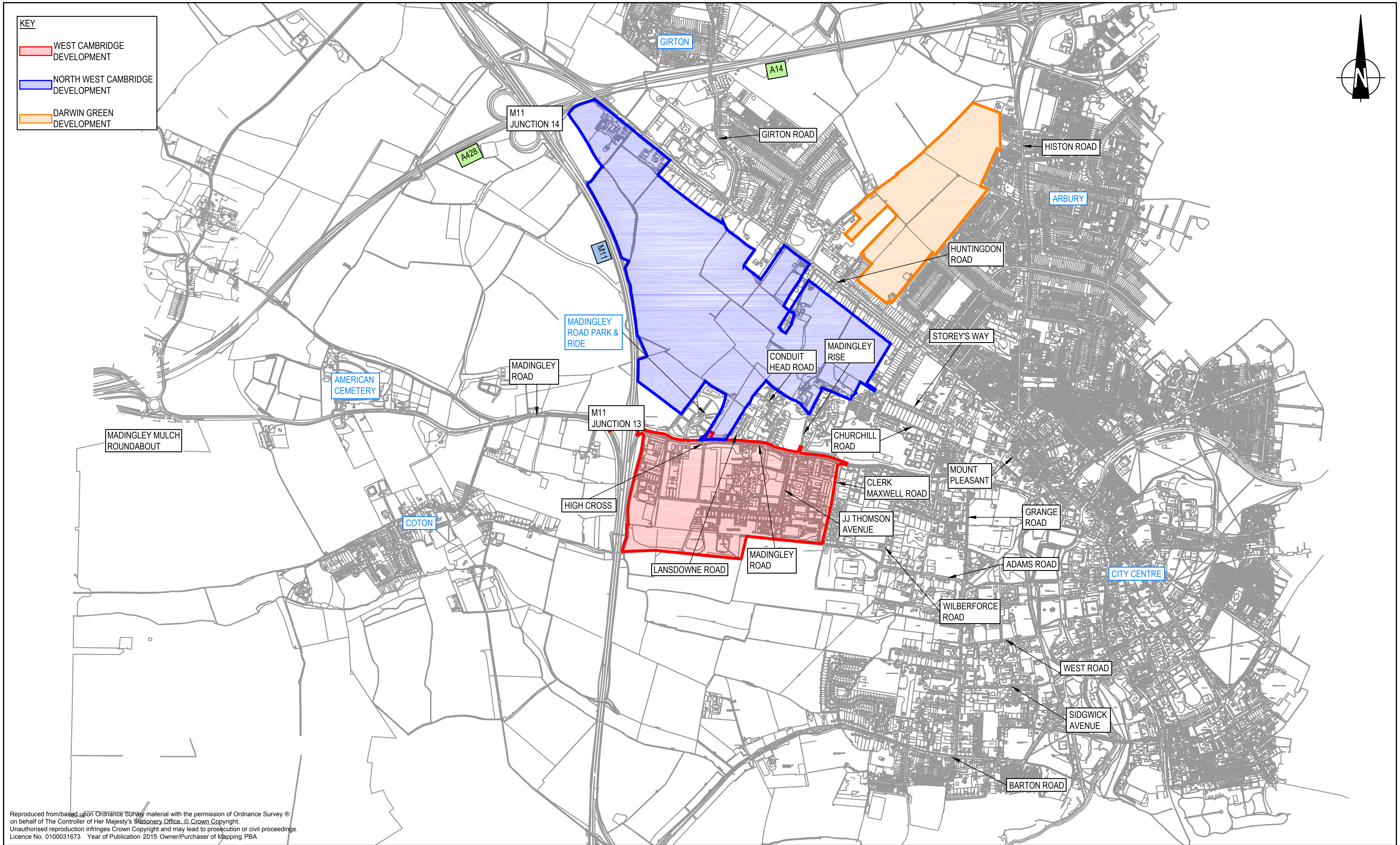

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WEST CAMBRIDGE DEVELOPMENT

LOCAL CONTEXT PLAN

Mark	Revision	Date	Drawn	Chkd	Appd

Drawing Status
TRANSPORT ASSESSMENT

Date of 1st Issue	SEP 2017		
A3 Scale	NTS		
Design		Drawn	DS
Chkd	JH	Appd	JH

Drawing Number: FIGURE 2.2
Revision: -

user name: jonathon coles

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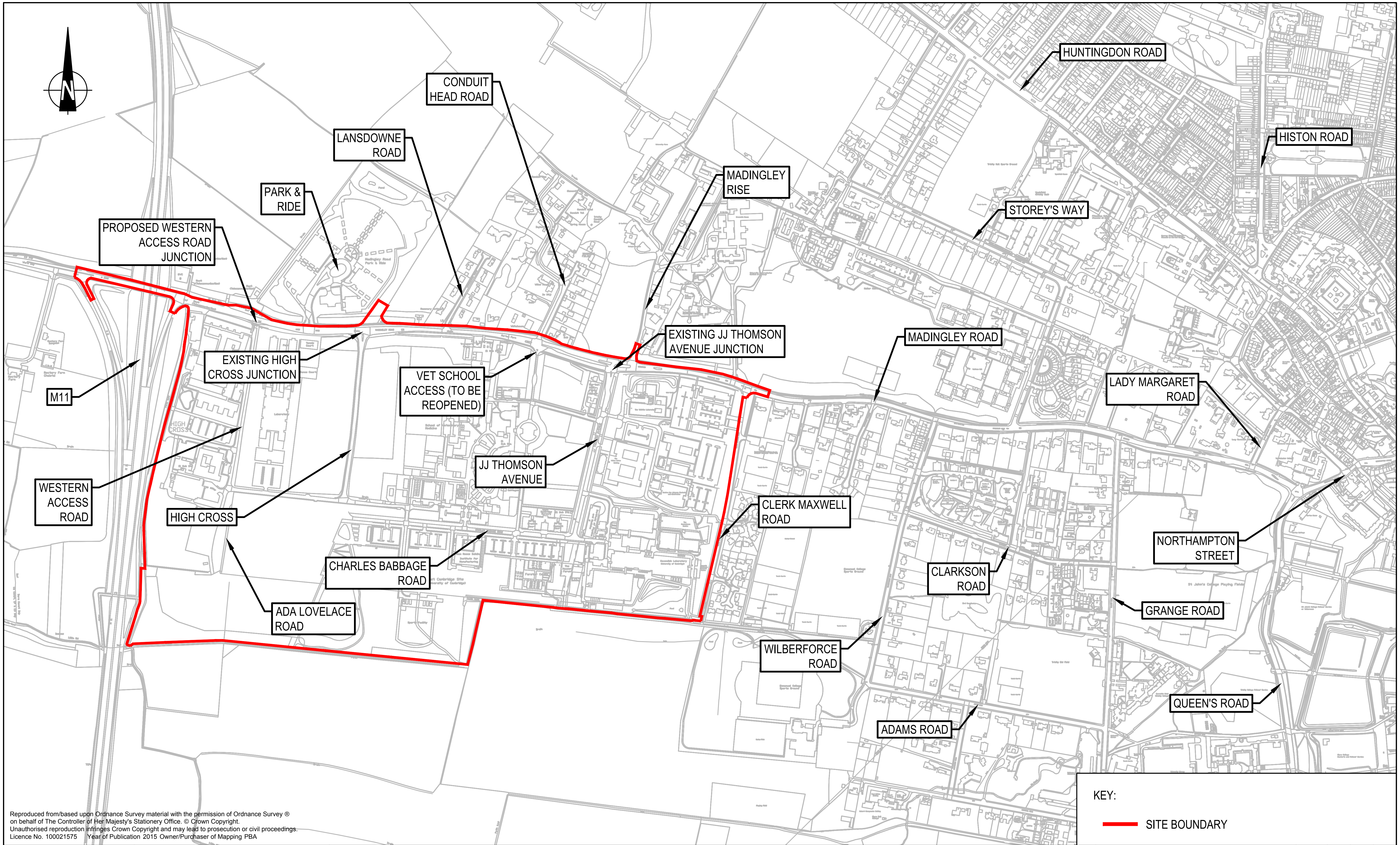

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WEST CAMBRIDGE

LOCAL ROAD NETWORK

Mark	Revision	Date	Drawn	Chkd	Appd

Drawing Status: TRANSPORT ASSESSMENT

Date of 1st Issue	SEP 2017
A3 Scale	NTS
Design	Drawn DS
Chkd PC	Appd

Drawing Number: FIGURE 2.3

Revision: -

user name: jonathon coles

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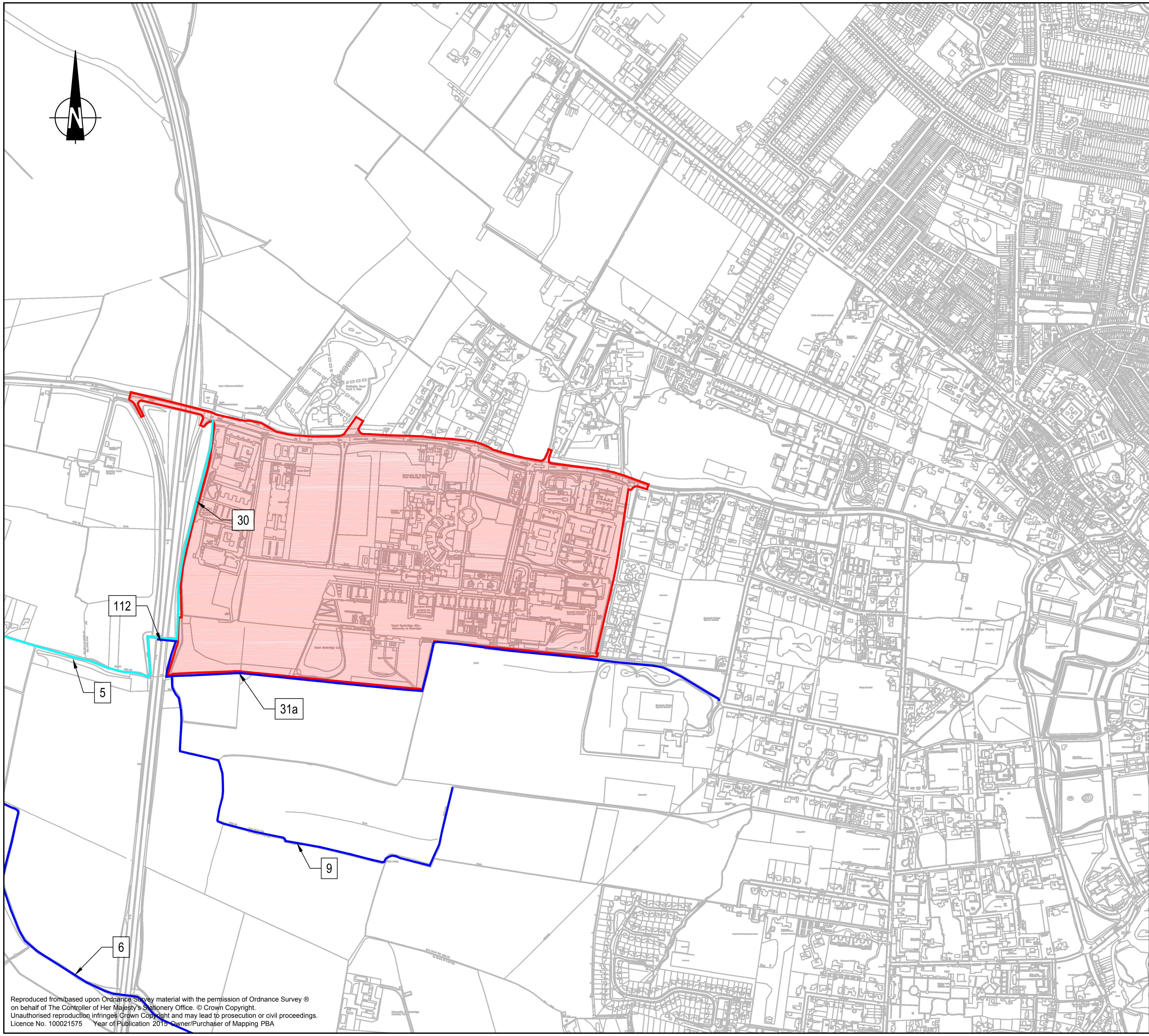

KEY:

30		BRIDLEWAY
9		FOOTPATH
		SITE BOUNDARY

Mark	Revision	Date	Drawn	Chkd	Appd

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Drawing Issue Status

TRANSPORT ASSESSMENT

WEST CAMBRIDGE

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Date of 1st Issue	Designed	Drawn
SEP 2016	-	DS
A3 Scale	Checked	Approved
NTS	PC	-

Drawing Number	Revision
FIGURE 3.1	-

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Maximum building heights

- 31.0 metres AOD
- 32.0 metres AOD
- 33.0 metres AOD
- 35.0 metres AOD
- 36.0 metres AOD
- 37.0 metres AOD
- 38.0 metres AOD
- 41.0 metres AOD
- See Parameter Plan 05 for maximum AOD height

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Notes:

Camera information:
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Date, time and weather information:
2016-02-25, weather as per photographs, direction as per photolocation plan

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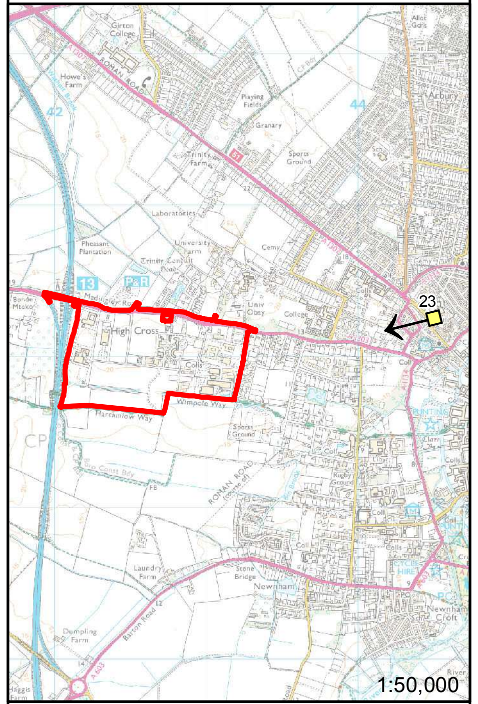

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Title
Landscape
Photomontage Views
Viewpoint 23 - Winter, Proposed
Sheet 32 of 32

Sheet Size	Original Scale	Designed / Drawn	Checked	Authorised
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Drawing Number	Rev
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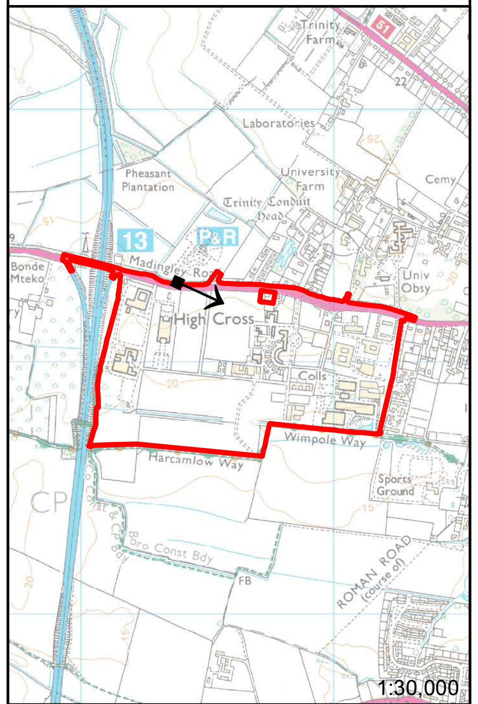

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Title

Landscape
Photomontage Views
Madingley Road Viewpoint - 24 - Existing
Sheet 1 of 6

Sheet Size	Original Scale	Designed / Drawn	Checked	Authorised
A3	N/A	SJD	HM	DP
		Date 14/07/17	Date 14/07/17	Date 14/07/17

Drawing Number	Rev
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Maximum building heights

- 31.0 metres AOD
- 32.0 metres AOD
- 33.0 metres AOD
- 35.0 metres AOD
- 36.0 metres AOD
- 37.0 metres AOD
- 38.0 metres AOD
- 41.0 metres AOD
- See Parameter Plan 05 for maximum AOD height

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Notes:

Camera information:
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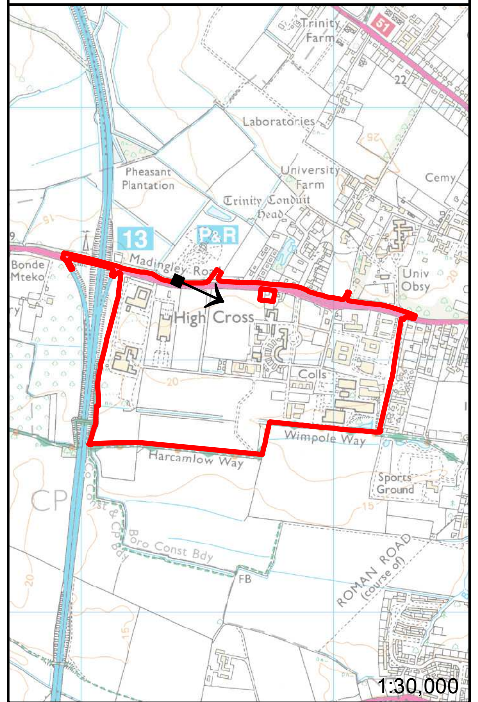

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Title

Landscape
Photomontage Views
Madingley Road Viewpoint - 24 - Proposed
Sheet 2 of 6

Sheet Size	Original Scale	Designed / Drawn	Checked	Authorised
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		Date 14/07/17	Date 14/07/17	Date 14/07/17

Drawing Number	Rev
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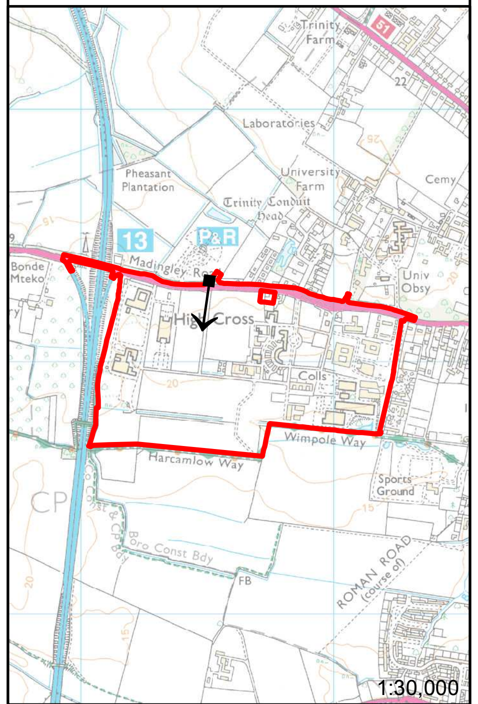

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Title
Landscape
Photomontage Views
Madingley Road Viewpoint - 25 - Existing
Sheet 3 of 6

Sheet Size	Original Scale	Designed / Drawn SJD	Checked HM	Authorised DP
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Drawing Number	Rev
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Maximum building heights

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- 32.0 metres AOD
- 33.0 metres AOD
- 35.0 metres AOD
- 36.0 metres AOD
- 37.0 metres AOD
- 38.0 metres AOD
- 41.0 metres AOD
- See Parameter Plan 05 for maximum AOD height

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Notes:

Camera information:
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Date, time and weather information:
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Viewpoint height:
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Correct viewing distance from viewer to photomontage:
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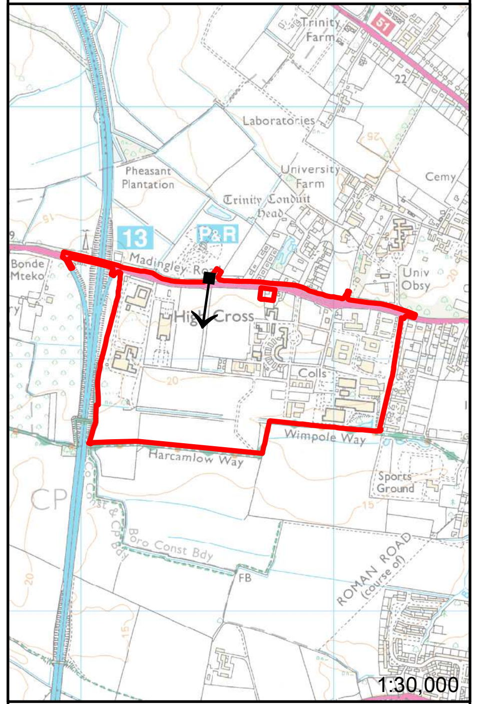

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Title
Landscape
Photomontage Views
Madingley Road Viewpoint - 25 - Proposed
Sheet 4 of 6

Sheet Size	Original Scale	Designed / Drawn	Checked	Authorised
A3	N/A	SJD	HM	DP
		Date 14/07/17	Date 14/07/17	Date 14/07/17

Drawing Number	Rev
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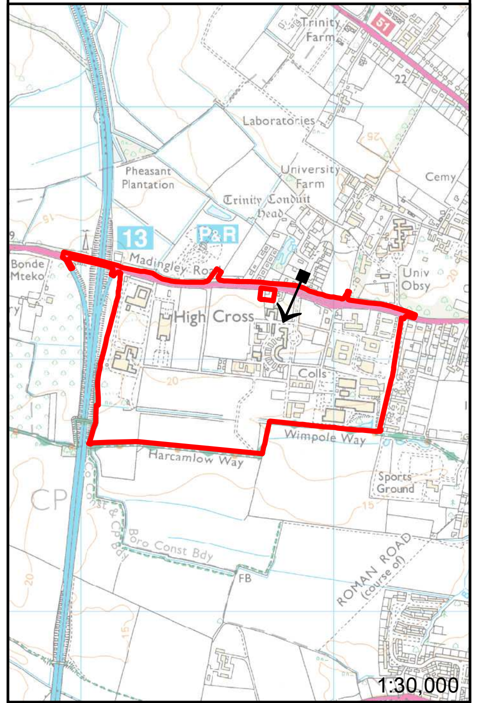

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Title
Landscape
Photomontage Views
Madingley Road Viewpoint - 26 - Existing
Sheet 5 of 6

Sheet Size	Original Scale	Designed / Drawn SJD	Checked HM	Authorised DP
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Drawing Number	Rev
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Path: P:\GBLOW\LEGE\PLH\Planning\Projects\5137998 West Cambridge Masterplan EIA\600 Working Folders\670 GIS\WIP\LV\5137998_CAM_LV_PMMR3E_01_GEO125.mxd

Maximum building heights

- 31.0 metres AOD
- 32.0 metres AOD
- 33.0 metres AOD
- 35.0 metres AOD
- 36.0 metres AOD
- 37.0 metres AOD
- 38.0 metres AOD
- 41.0 metres AOD
- See Parameter Plan 05 for maximum AOD height

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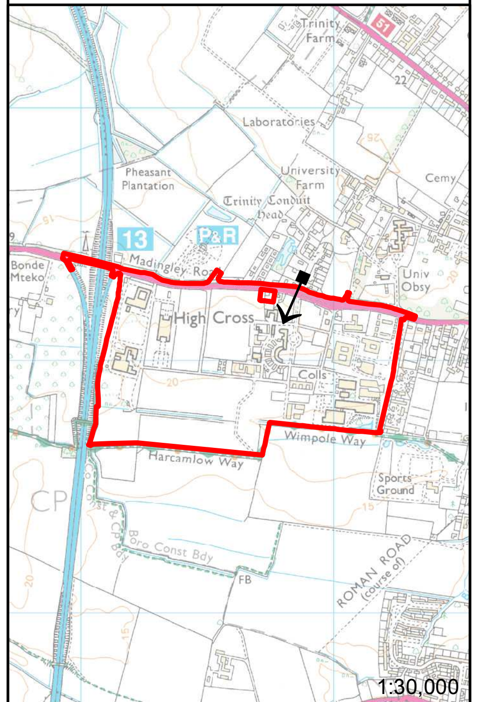

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Title
Landscape
Photomontage Views
Madingley Road Viewpoint - 26 - Proposed
Sheet 6 of 6

Sheet Size	Original Scale	Designed / Drawn	Checked	Authorised
A3	N/A	SJD	HM	DP
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Drawing Number	Rev
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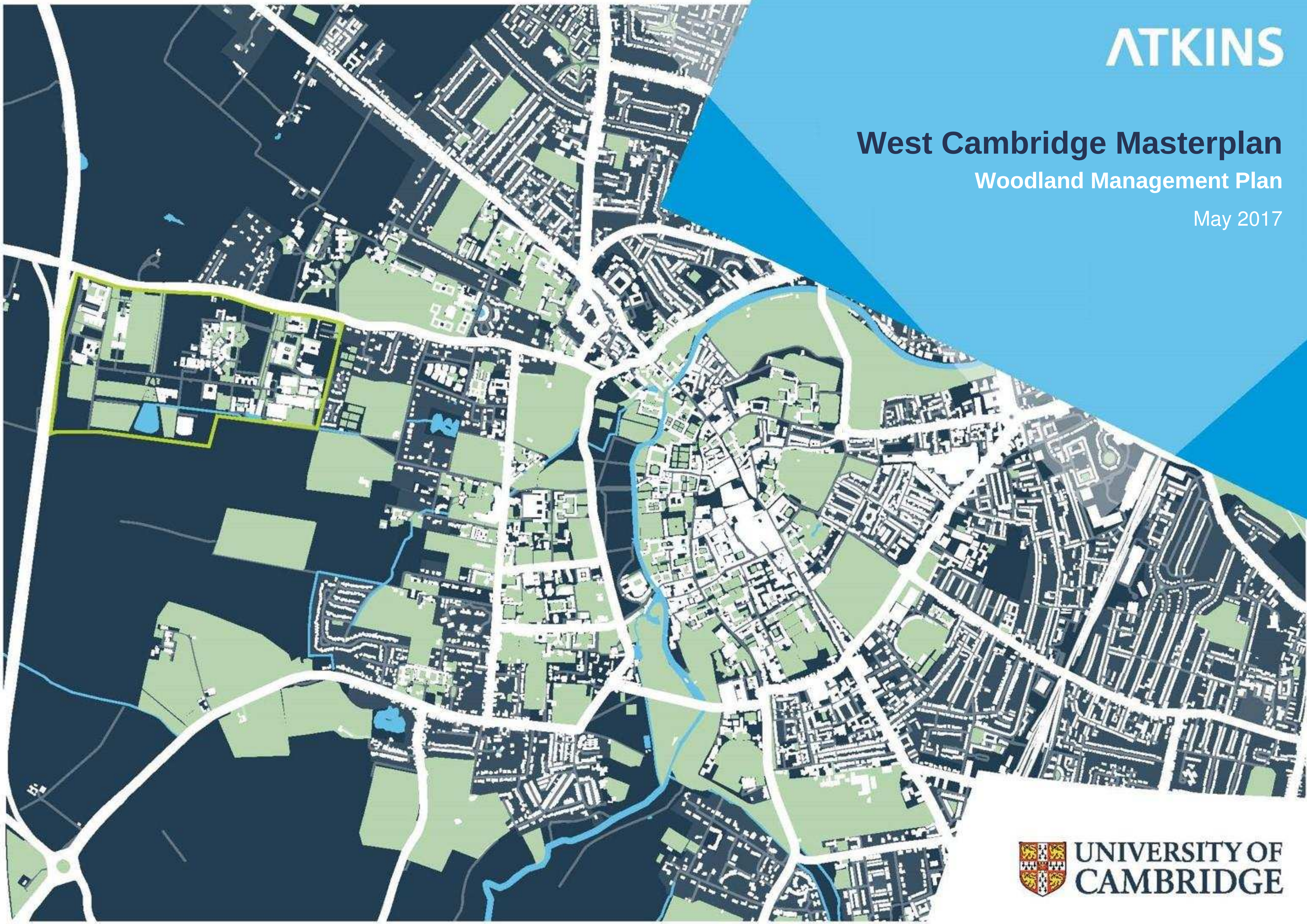
Appendix 8.4 Woodland Management Plan



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West Cambridge Masterplan

Woodland Management Plan

May 2017

UNIVERSITY OF CAMBRIDGE

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Document History

Job number: 5137998			**Document ref: 5137998-WMP**			
Revision	**Purpose description**	**Originated**	**Checked**	**Reviewed**	**Authorised**	**Date**
Rev 1.0	Draft	TD	AA	DP	PW	07/12/16
Rev 2.0	Draft	TD	AA	DP	PW	22/12/16
Rev 3.0	Draft	TD	AA	DP	PW	11/01/17
Rev 4.0	Draft	TD	AA	DP	PW	16/02/17
Rev 5.0	Draft	TD	AA	DP	PW	26/04/17
Rev 6.0	Draft	TD	AA	DP	PW	12/05/17
Rev 7.0	Final	TD	AA	DP	PW	16/05/17

Contents

1. Introduction

1.1 Terms of reference

1.1.1 Atkins Limited (Atkins) has been commissioned by the University of Cambridge to produce a 'Woodland Management Strategy' for boundary tree groups at the West Cambridge site as part of the outline planning application (OPA) for the development of the West Cambridge site.

1.1.2 This 'Woodland Management Strategy' has been prepared to provide management principles and objectives for the tree and shrub groups which are to be retained on the boundaries of the West Cambridge site, and occasional groups which are more central that have been identified for inclusion by the council. This is to address concerns from Cambridge City Council over their lack of management. Similarly, if a management regime is not implemented then the condition of the groups will deteriorate, meaning they will no longer meet the requirements of their particular landscape function.

1.1.3 The requirements for this strategy were identified as an action during a Post Submission workshop with Cambridge City Council on 1st November 2016.

1.1.4 The council made reference to the production of an 'Existing Vegetation Management Strategy', to include; the identification of all existing vegetation; the condition of the vegetation; whether the vegetation is identified for removal at Outline stage; and protection of existing vegetation.

1.1.5 All of this information has already been produced as part of the Outline Planning Application and is contained within the produced Arboricultural Impact Assessment and accompanying Tree Protection Plans for the Outline Planning Application. Accordingly, this strategy focuses on the following information:

- Identify landscape function of woodland tree groups.
- Preparation of woodland management principles for the boundary woodland and tree groups recorded on the West Cambridge site, as these areas cover potential conflicts with the proposed building zones on site and they are important for screening functions to views in and out of the site;
- The management principles apply solely to the woodland tree groups that are growing directly on the boundaries of the site and incorporating a mixture of tree and shrub species. It omits individual trees or tree groups containing individually recorded trees because these have not been planted or growing as woodland screens.
- Capturing data in line with the UK Woodland Assurance Standard Third Edition (version 3.1) (http://ukwas.org.uk/wp-content/uploads/2012/05/UKWAS-Third-Edition-version-3.1-20122.pdf) which is a published certification standard defining appropriate and effective woodland management for the UK;
- The assessment of each woodland or group edge for canopy tree species, i.e. those that are capable of being long lived. The tagging of pertinent trees by the Arboriculturists for plotting by a land survey team that will follow on behind the arboriculturists to make sure these trees are plotted to influence the offsets required for the building zones .

1.1.6 All of this information forms part of this 'Woodland Management Strategy' report and is supplemented by plans covering their locations.

1.2 Tree groups

1.2.1 The following boundary woodland and tree groups are included within this strategy, the reference numbers correspond to the Atkins Arboricultural Impact Assessment and Tree Protection Plans for the West Cambridge site;

- Woodland references – W1, W2, W3A-B & W4A-C which run along part of the southern boundary and all of the western boundary;
- Tree groups – G019, G041, G090, G105, G116, G016A-E, G003, G002, G024A which run along the site's north, south and east boundaries.

1.3 Scope of works

1.3.1 This report presents information captured on 17th & 18th November 2016 by Atkins' Arboricultural Team Leader Tom Dale BSc (Hons), Cert Arb (L6 (ABC), M.Arbor.A, and Atkins' Landscape and Arboricultural Consultant Adam Atkins, BA (Hons) CMLI, TechCert (ArborA).

1.4 Purpose of plan

1.4.1 This report covers the long-term management of specific woodland or tree group within the West Cambridge site for the woodland/trees to continue to meet their landscape functions, including screening, and to provide the setting for longer lived tree species to thrive and develop into large mature specimens of cultural, arboricultural and landscape significance.

1.4.2 If these trees or woodlands are left unmanaged the condition of the vegetation will deteriorate over-time. This is through competition for sunlight and resources. The effects of which will inhibit the slower growing species and lead to slender trees and shrubs of limited crown extents, reducing screen functions and significantly increasing the risk of tree failures through wind-throw and a loss of vitality.

1.4.3 This management plan will also provide a central document for the University to adopt for the site and will form the basis on which future developers need to adhere to should they wish to build on a plot within the West Cambridge site. Placing the emphasis on producing sympathetic designs on which to retain existing trees/woodlands, rather than blanket removal.

2. Method

2.1 Survey method

2.1.1 The survey was a non-invasive ground level assessment looking specifically at the tree and shrub populations within the groups.

2.1.2 Tree groups were assessed by Atkins' Arboriculturists to identify the following information in line with the UK Woodland Assurance Standard Third Edition (version 3.1) (http://ukwas.org.uk/wp-content/uploads/2012/05/UKWAS-Third-Edition-version-3.1-20122.pdf) which is a published certification standard defining appropriate and effective woodland management for the UK;

- Define long-term management principles for the woodland or group;
- Assessment of the relevant aspects of the woodland or group resource – e.g. species, age, vitality, spacing, current management;
- Identify any special characteristics and sensitivities of the woodland or group and appropriate treatments;
- Set objectives;
- Rationale for management prescriptions;
- Outline the planned felling and regeneration over the next 20 years – including specific measures to enhance, where possible, the areas assessed. The 20 years is the maximum period of time the guidance recommends given the significant changes that can occur within that 20 year period, most notably the potential arrival and spread of Ash dieback disease which could result in the mortality of the majority of Ash trees on site.

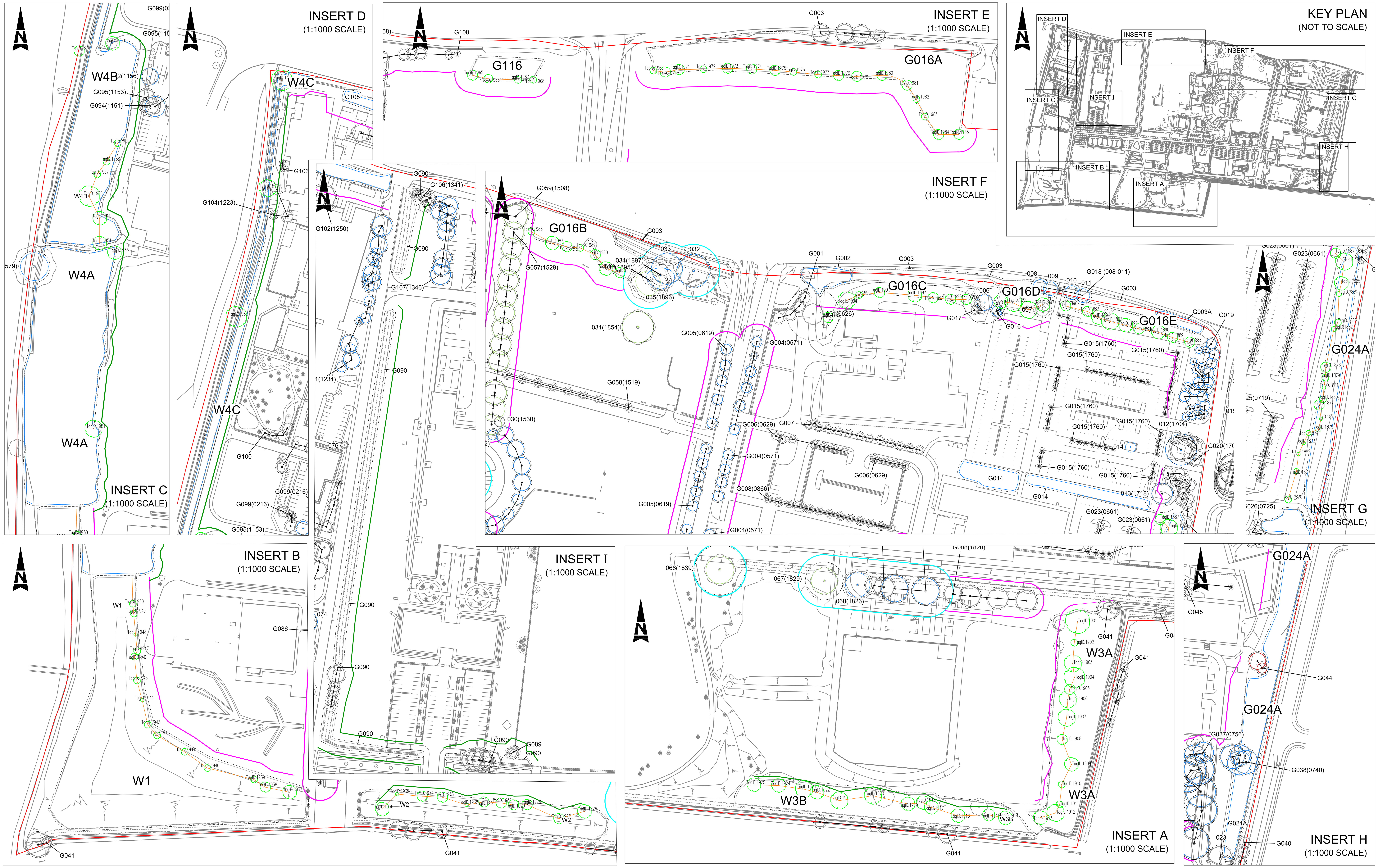
2.2 Limitations to survey

2.2.1 The survey is an assessment of the woodland or group as a whole, meaning individual trees were not inspected to inform on their retention values or safe useful life expectancies. Where dangerous or dead trees were identified, reasonable management prescriptions have been made as part of this strategy to cover the required works.

2.2.2 The survey did not involve the tagging of all the individual canopy trees along their boundaries with the building zones, as this would have resulted in a significant number of trees. Instead the survey picked up canopy tree species at intervals of approximately 5m – 10m. This is deemed reasonable in order to gain an average offset of the larger trees from the woodland edges.

2.3 Survey locations

2.3.1 The location of the groups are illustrated on Figure 2.1. Appendix C shows Figure 2.1 with enlarged detail.



TREE PROTECTION KEY

- 000 CATEGORY A TREE + TREE REF.
- 000 CATEGORY B TREE + TREE REF.
- 000 CATEGORY C TREE + TREE REF.
- 000 CATEGORY U TREE + TREE REF.
- G1 TREE GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)
- W1 WOODLAND GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)
- ROOT PROTECTION AREA
- EXTENT OF OUTER EDGE TREE STEMS OF WOODLAND/ GROUPS
- 5M BUFFER FROM TREE STEM TO BUILDING EDGE
- 8M BUFFER FROM TREE STEM TO BUILDING EDGE
- 10M BUFFER FROM TREE STEM TO BUILDING EDGE
- 15M BUFFER FROM TREE STEM TO BUILDING EDGE

Stat	Purpose of Issue	Date	Auth
	PLANNING	02/12/16	TD

Rev	Description	By	Date	Chk'd	Auth
E	INCLUSION G090	BC	12/05/17	TD	TD
D	UPDATE BUFFER ZONES	BC	26/04/17	TD	TD
C	UPDATE BUFFER ZONES	BC	16/02/17	TD	TD
B	OMIT 10M & 20M OFFSETS	BC	22/12/16	TD	TD
A	ADD 10M & 20M OFFSETS	BC	06/12/16	TD	TD
–	ORIGINAL	BC	02/12/16	TD	TD

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Client
UNIVERSITY OF CAMBRIDGE

Project
WEST CAMBRIDGE MASTERPLAN (EIA)

Title
WOODLAND MANAGEMENT PLAN
FIGURE 2.1

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A1	1:500	BC Date 02/12/16	TD Date 02/12/16	TD Date 02/12/16

Status	Drawing Number	Rev
P	5137998_COL_ARB_101	E

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3. General management principles

3.1 General

3.1.1 These groups of trees are boundary features, as such their primary function is for screening to views in and out of the site. This means that there are general management principles which are applicable to all of the groups and these are listed below:

- Resilience – implement correct management to ensure that the groups still provide screening functions into the future;
- Biodiversity – implementing correct management for the benefit of biodiversity, identifying and exploiting opportunities to increase the level of biodiversity;
- Continuity of cover – implement correct management to ensure continuous cover;
- Legacy – implement correct management to enable the development of selected individual specimen trees within some of the larger groups;
- Legal compliance – implement correct management that complies with the legal requirements relevant to the management undertaken.

3.1.2 These are the principles to which management objectives shall be prescribed for each of the boundary groups.

3.2 Resilience

3.2.1 This management principle is related to the ability of the woodland or group to continue to function as an effective screen and shall be underpinned by the following aims:

- Create a diverse structure to include variations in age, tree form, layering and the distribution of deadwood.
- Create dense young growth created by coppicing and promoting a varied vertical structure within the group.
- Implement management practices to move away from a single species dominating the planting composition, to mitigate for potential pests and disease or climate change.
- Early identification of any pests and diseases, and the implementation of corrective measures as appropriate.

3.3 Biodiversity

3.3.1 This management principle is related to implementing correct management for the benefit of biodiversity and shall be underpinned by the following aims:

- Identify any special characteristics or sensitivities of the woodland/group through consultation with the project team's Ecologist and implement appropriate treatments.
- Check the relevant Habitat Action Plans (HAPs) or Species Action Plans (SAPs) in the UK Biodiversity Action Plan and Local Authority's Biodiversity Action Plans(BAPs).

3.4 Continuity of cover

3.4.1 This management principle is related to the ability of the woodland to continue to function as an effective screen and shall be underpinned by the following aims:

- Maintain a woodland canopy during the implementation of management by selective thinning, rather than any clear felling operations.
- Ensure regeneration failures are kept to a minimum through implementing management practices to limit browsing potential and through managing surrounding vegetation to reduce competition.

3.5 Legacy

3.5.1 This management principle is related to managing the woodland to enable selected individual specimen trees to develop and achieve their full growth potential and shall be underpinned by the following aims:

- Maintain adequate space around the selected trees free from competition.
- Ensure these trees have a minimum of 15m offset from the building zones.

3.6 Legal compliance

3.6.1 This management strategy will have to comply with the legal requirements relevant to the management undertaken including:

Forestry Act 1967 (as amended)

- Felling licences are covered within the Forestry Act 1967;
- The Forestry Act 1967 makes it an offence to fell licensable trees without having obtained a licence or other valid permission;
- Licensable trees are those that fall outside of the exemptions detailed below;
- Fines or a re-stocking notice can be served if an offence can be proved and convicted;
- Any fines or re-stocking notices will be served by the Forestry Commission, not the Local Planning Authority.

Relevant Exemptions

- In any calendar quarter you may fell 5 cubic metres of timber without a licence;
- A calendar quarter is defined as 1st Jan to 31st March, 1st April to 30th June, 1st July to 30th September and 1st October to 31st December;
- Felling trees which, when measured at a height of 1.3m from the ground have a diameter of 80mm or less;
- Felling trees with a diameter of 100mm or less for the purpose of thinning a tree group;

Plant Health Act 1967

3.6.2 All tree works are to be undertaken in line with current recommendations in accordance with BS3998:2010 Tree work – Recommendations and shall comply with the most recent advice and guidelines from the Arboriculture and Forestry Advisory Group (AFAG), the Forestry Industry Safety Accord (FISA), or the Health and Safety Executive (HSE) .

3.6.3 The tree works contractor will have to submit a risk assessment and method statement for review by the University of Cambridge prior to commencing works on site.

Conservation of Habitats and Species Regulations 2010 (as amended) – specifically in regards to Bats, Dormice, Wild Plants

3.6.4 Tree works are to be planned to ensure protection of people, property and wildlife. If the works are to be undertaken during the bird nesting season then advice is to be sought from an Ecologist prior to undertaking tree works.

Wildlife and Countryside Act 1981 (as amended).

3.6.5 Where a group contains protected, rare and endangered flora and fauna then the works may require specific notification or permission to be obtained from the applicable governing body to undertake any works. Table 3.1 summarises applicable types of offences and licensing procedures and guidance.

Table 3.1 Wildlife and Countryside Act 1981 offences, licensing procedures, and guidance

Species	Legislation (England & Wales)	Offences	Licensing procedures and guidance (England & Wales)
Bats European protected species	Conservation of Habitats and Species Regulations 2010 (as amended) Reg 41	Deliberately capture, injure or kill a bat; deliberate disturbance of bats; or damage or destroy a breeding site or resting place used by a bat. [The protection of bat roosts is considered to apply regardless of whether bats are present.]	A Natural England (NE) licence in respect of development is required in England or a licence from the Welsh Assembly Government in consultation with Natural Resources Wales (NRW) in Wales. European Protected Species: Mitigation Licensing- How to get a licence (NE 2010) Bat Mitigation Guidelines (English Nature 2004) Bat Workers Manual (JNCC 2004)
	Wildlife and Countryside Act 1981 (as amended) S.9	Intentionally or recklessly obstruct access to any structure or place used for shelter or protection or disturb a bat in such a place.	Licence from NE or NRW is required for surveys (scientific purposes) that would involve disturbance of bats or entering a known or suspected roost site.
Dormouse European protected species	Conservation of Habitats and Species Regulations 2010 (as amended) Reg 41	Deliberately capture, injure or kill a dormouse; deliberate disturbance of a dormouse; or damage or destroy a breeding site or resting place used by a dormouse.	A Natural England licence in respect of development is required in England or a licence from Natural Resources Wales (NRW) in Wales. European Protected Species: Mitigation Licensing- How to get a licence (NE 2010) Dormouse Conservation Handbook (English Nature 2006)
	Wildlife and Countryside Act 1981 (as amended) S.9	Intentionally or recklessly obstruct access to any structure or place used for shelter or protection or disturb a dormouse in such a place.	Licence issued for survey and conservation by Natural England or Natural Resources Wales.
Birds	Wildlife and Countryside Act 1981 (as amended) S.1	Intentionally kill, injure or take any wild bird; intentionally take, damage or destroy the nest of any wild bird while that nest is in use or being built; intentionally take or destroy the nest or eggs of any wild bird. [Special penalties are liable for these offences involving birds on Schedule 1 (e.g. most birds of prey, kingfisher, barn owl).] Intentionally or recklessly disturb a Schedule 1 species while it is building a nest or is in, on or near a nest containing eggs or young; intentionally or recklessly disturb dependent young of such a species.	No licences are available to disturb any birds in regard to development. Licences are available in certain circumstances to damage or destroy nests, but these only apply to the list of licensable activities in the Act and do not cover development. General licences are available in respect of 'pest species' but only for certain very specific purposes e.g. public health, public safety, air safety.
Plants European protected species	Conservation of Habitats and Species Regulations 2010 (as amended); Reg.45	Deliberately pick, collect, cut, uproot or destroy a wild plant of a European protected species (Schedule 5).	Licences can be issued for science, education and conservation and also in respect of a development if it is of overriding public interest. Since the 21st August 2007 it is no longer a defence to show that the picking, cutting, collecting, uprooting or destruction of a wild European Protected Species of plant was the incidental and unavoidable result of an otherwise lawful activity. European Protected Species: Mitigation Licensing- How to get a licence (NE 2010) Licences can also be issued for destructive survey methods for floating water plantain, where non-destructive methods are insufficient to determine presence (Guidance on sampling rare aquatic plants, NE 2009).
Plants Nationally protected species	Wildlife and Countryside Act 1981 S.13 (Schedule 8)	Intentionally pick, uproot or destroy any wild plant on Schedule 8	Licences can be issued by Natural England for specific purposes only, such as science and education or conservation purposes. There is no provision for licensing the above actions for development operations under the Wildlife & Countryside Act 1981 (as amended). Such actions can only proceed if they are covered by the appropriate defence in the Act, which permits otherwise illegal activities if they are the 'incidental result of a lawful operation and could not reasonably have been avoided'. Only a court can decide what is 'reasonable' in any set of circumstances. No licence is required for survey in England or Wales. Guidance on survey techniques is available from Natural England.
Plants All plants	Wildlife and Countryside Act 1981 S.13	To uproot any wild plant without authorisation.	No licence is required. The land owner's permission is required. (England and Wales)

4. Existing conditions

4.1 Existing plot details

4.1.1 Table 4.1 provides details on the existing woodland groups and specifically the opportunities for management:

Table 4.1 Existing woodland and tree groups and management opportunities

Group reference	Species	Age	Current layout and spacing	Current management & vitality	Public access	Invasive Species	Amount of regeneration	Current protection	Current observations, issues and opportunities
W1 1937 to 1950	Trees: Common Oak, Common Ash, Silver Birch, Aspen, Cherry, Field Maple Shrubs: Hawthorn, Hazel, Blackthorn	Young	Growing on earth mound, triangular shape. Average 2m spacings between rows and plants, planting rows from 7 to 12 in places. Staggered hedgerow on south boundary. No management recorded, stock now leggy and drawn. Groups of multi-stem hazel and other pockets of odd-numbered shrubs. Existing variation in vertical structure – between shrub and tree stock. No woodland edge habitat on boundary with building zone.	No recent management record. Good vitality, occasional dead trees resulting from over competition	No	Areas of bramble	Low – occasional self-sown Alder & Ash saplings. Wet, saturated areas opposite building zone on north edge of group being colonised by Alder.	Tree/shrub guards still attached to majority of stock	Relatively sparse on the crest of the earth mound at the south west corner, where planting becomes intermittent, with trees at 2.5-4m spacings Tree/shrub guards restricting growth in places. Ash dominating tree species. Aspen present which can outcompete more preferable or higher value species. No management undertaken on southern hedgerow. Close spacing between trees/shrubs restricting crown formations. Landscape function – Shelter belt and woodland group
W2 1926 to 1936	Trees: Common Oak, Common Ash, Aspen, Cherry, Field Maple Shrubs: Hawthorn, Hazel, Elder, Guelder Rose	Young	Growing on earth mound, rectangular shape Average 1.5-2m spacings between rows and plants. Approximately 8 rows. Staggered hedgerow on south boundary. No management recorded, stock now leggy and drawn. Groups of multi-stem hazel and other pockets of odd-numbered shrubs. Limited variation in vertical structure. No woodland edge habitat on boundary with building zone.	No recent management record. Good vitality	No	None	Low – occasional self-sown Elder	Tree/shrub guards still attached to majority of stock	Tree/shrub guards restricting growth in places. No management undertaken on southern hedgerow. Close spacing between trees/shrubs restricting crown formations. Relatively uniform height throughout. Aspen present which can outcompete more preferable species or higher value species. Landscape function – shelter belt

Group reference	Species	Age	Current layout and spacing	Current management & vitality	Public access	Invasive Species	Amount of regeneration	Current protection	Current observations, issues and opportunities
W3A 1901 to 1913	Trees: Common Oak, Common Ash, Field Maple, Scots Pine, Cherry, Apple Shrubs: Hawthorn, Elder	Young to semi-mature	Growing on level ground as a rectangular plot. Earth bund to west of group. Planted in diagonal rows, each row approximately 5m apart. The plants in the rows are growing at approximately 2m spacings. Scots Pine more prevalent in southern extents – largely failed to establish with dead stems present. Intermittent hedgerow planting on west extents, largely failed to establish, occasional shrubs remaining. There is a mature field boundary hedgerow outside of group to the east which has intermittent gaps, with the specimens having received no recent management with leggy and drawn stems on existing shrubs. No woodland edge habitat on boundary with building zone.	No recent management record. Good vitality, on broad leaf specimens, poor on coniferous trees with occasional dead stems of Scots Pine present from over competition.	There are signs of public access, with desire lines to the north of the group.	Dense pockets of bramble	Low – occasional self-sown Elder and Ash & Oak saplings	Open boundary to east. Occasional tree stake still attached.	Limited shrub species, and relatively uniform vertical structure. Standing dead trees. Scots Pine failing to thrive throughout the majority of the group. No management undertaken on eastern hedgerow. West woodland edge planting failed to establish. Close spacing between trees/shrubs restricting crown formations. Limited understorey vegetation. Landscape function – Shelter belt and woodland group
W3B 1914 to 1925	Trees: Common Oak, Common Ash, Aspen, Cherry, Field Maple, Alder Shrubs: Hawthorn, Hazel, Elder, Dogwood	Young	Growing on level ground as a rectangular plot. Average 1-1.5m spacings between plants. Planted hedgerow on southern boundary. No management recorded, stock now leggy and drawn. Groups of multi-stem hazel and other pockets of odd-numbered shrubs. Limited variation in vertical structure. No woodland edge habitat on boundary with building zone.	No recent management record. Good vitality	No	Pockets of bramble in places	Low – occasional self-sown Elder	Tree/shrub guards still attached to majority of stock	Tree/shrub guards restricting growth in places. No management undertaken on southern hedgerow. Close spacing between trees/shrubs restricting crown formations. Relatively uniform height throughout. Aspen present which can outcompete with more preferable species. Ash dominating tree species. Landscape function – Shelter belt
W4A 1951 & 1953	Trees: Elm Shrubs: Hawthorn, Elder	Young to over-mature	Growing as a rectangular plot. Average 5m spacings between plants. No planted stock, all natural regeneration. Limited variation in vertical structure. No woodland edge habitat on boundary with building zone.	No recent management record. Fair vitality, standing dead stems in places with some collapsed.	Public footpath runs parallel to western edge.	Pockets of bramble in places	Medium – majority of plants have naturally regenerated	Timber panelled fence between group and building zone.	Hawthorn dominant species. Collapsed and dead stems in places through neglect, windthrow and competition for light inducing drawn and unbalanced crowns. Occasional Elm sapling. Dutch Elm Disease prevalent, with standing dead stems. Limited understorey, dense canopy cover from Hawthorn crowns intertwining. Landscape function – Scrub woodland

Group reference	Species	Age	Current layout and spacing	Current management & vitality	Public access	Invasive Species	Amount of regeneration	Current protection	Current observations, issues and opportunities
W4B 1954 to 1960	Trees: Common Ash, Norway Maple, Sycamore, Crack Willow Shrubs: Hawthorn, Blackthorn, Elder	Young to mature	Rectangular plot. Earth mound on its north extents covered with largely self-sown scrub vegetation. Dominated by natural regeneration. A 3-5m band of sycamore on south east corner. The majority have self-sown. Average of 3m spacings between plants. Limited variation in vertical structure. No woodland edge habitat on boundary with building zone.	Current management of scrub vegetation to keep access road clear. Fair vitality, standing dead stems in places with some collapsed.	Public footpath runs parallel to western edge and internal access road to east.	Pockets of bramble and areas of Blackthorn scrub in places	Medium – majority of plants have naturally regenerated	No guards or protection in place	Hawthorn dominant species. Collapsed and dead stems in places through neglect, windthrow and competition for light inducing drawn and unbalanced crowns. Occasional Sycamore with a number of saplings having self-sown on south east corner of the group. Limited understorey, dense canopy cover from Hawthorn crowns intertwining. The earth mound is heavily infested by rabbits, meaning the potential to enhance this area with new planting will require pest control and adequate protection in order for the plants to establish. Landscape function – Scrub woodland
W4C 1962 to 1964	Trees: Horse Chestnutx1, Common Ashx1, Elm Shrubs: Hawthorn, Blackthorn, Elder	Young to mature	Lapsed hedgerow. Not continuous, occasional gaps. 6m walkway between group and the highway plot to west. Successional growth from blackthorn scrub. No defined uniform hedgerow.	Current management of scrub vegetation to keep access road clear. Fair vitality, standing dead stems in places with some collapsed.	Public footpath runs parallel to western edge and internal access road to east.	Pockets of bramble and areas of Blackthorn scrub in places	Low – pockets of Blackthorn successional growth	No guards or protection in place	Limited species diversity. Collapsed and dead stems in places through neglect, windthrow and competition for light inducing drawn and unbalanced crowns. Standard trees limited to 2no. Gaps in places from collapsed stems. Dry ditch to west of group. Dense ivy clad stems from centre. Occasional Elm sapling, with Dutch Elm Disease present within group. Landscape function – Hedgerow
G116	Trees: Common Ash, Common Oak, Field Maple, Lime, Cherry, Scots Pine Shrubs: Hazel, Elder	Young	Rectangular plot. Growing on level ground. Planted plot with approximately 6 rows and an average of 1.5-2m spacings between trees. Limited variation in vertical structure. Groups of multi-stem hazel within group. No woodland edge habitat on boundary with building zone.	No active management recorded. Fair to good vitality, standing dead stems in places with dead Scots Pine trees.	No public access, fencing surrounds area	None observed	Low – occasional elder sapling	Rabbit proof fencing surrounds plot.	Close spacing between trees/shrubs restricting crown formations. Relatively uniform height throughout. Ash dominant tree species. Limited understorey vegetation due to dense canopy cover. Areas to east of group suitable for new planting. Landscape function – Shelter belt
G016A	Trees: Common Ash, Common Oak, Field Maple, Lime, Cherry, Whitebeam Shrubs: Hazel, Elder, Hawthorn	Young to semi-mature	Growing as a largely rectangular plot, on level ground. Planted plot with no obvious rows. Random planting configuration and an average of 2m spacings between trees. Limited variation in vertical structure. Groups of multi-stem hazel within group. No woodland edge habitat on boundary with building zone.	No active management recorded. Fair to good vitality, standing dead stems in places with dead trees.	No public access, fencing surrounds area	None observed	Low – occasional elder sapling	Rabbit proof fencing surrounds plot.	Close spacing between trees/shrubs restricting crown formations. Relatively uniform height throughout. Ash dominant tree species. Limited understorey vegetation due to dense canopy cover. Lapsed hedgerow to north of group along highway. High number of dead elms. Landscape function – Shelter belt

Group reference	Species	Age	Current layout and spacing	Current management & vitality	Public access	Invasive Species	Amount of regeneration	Current protection	Current observations, issues and opportunities
G016B	Trees: Common Ash, Common Oak, Silver Birch, Lime, Cherry, Whitebeam Shrubs: Hazel, Elder, Hawthorn	Young to semi-mature	Growing as a largely rectangular plot, on level ground. Planted plot with approximately 7no. rows, with 1.5-2m spacings between rows and trees. Limited variation in vertical structure. Groups of multi-stem hazel within group. No woodland edge habitat on boundary with building zone.	No active management recorded. Fair to good vitality, standing dead stems in places with dead trees.	No public access, fencing surrounds area	None observed	Low – occasional elder sapling	Rabbit proof fencing surrounds plot. However, this has been breached in places with girdled stems recorded from mammal grazing. The affected trees have largely died as a result.	Close spacing between trees/shrubs restricting crown formations. Relatively uniform height throughout. Ash dominant tree species. Limited understorey vegetation due to dense canopy cover. Lapsed hedgerow to north of group along highway. High number of dead elms. Rabbit damage on trees, therefore, repairs required to existing rabbit proof fencing and pest control in order to protect any new planting or coppiced trees/shrubs Landscape function – Shelter belt
G016C	Trees: Common Ash, Common Oak, Silver Birch, Lime, Cherry, Beech, Elm Shrubs: Hazel, Elder, Hawthorn	Young to semi-mature	Growing as a broadly rectangular plot on an earth mound. Planted plot with no obvious rows. Random planting configuration with 1-2m spacings between trees. Limited variation in vertical structure. Groups of multi-stem hazel within group. No woodland edge habitat on boundary with building zone.	No active management recorded. Fair to good vitality.	No public access, fencing surrounds area	None observed	Low – occasional Oak sapling and Elm	Rabbit proof fencing surrounds plot.	Close spacing between trees/shrubs restricting crown formations. Relatively uniform height throughout. Limited understorey vegetation due to dense canopy cover. Lapsed hedgerow to north of group along highway. High number of dead elms. Narrow plot. Landscape function – Shelter belt
G016D	Trees: Common Ash, Common Oak, Cherry, Beech Shrubs: Hazel, Hawthorn	Young to semi-mature	Growing as a broadly rectangular plot on level ground. Planted plot with no obvious rows. Random planting configuration with 1-2m spacings between trees. Limited variation in vertical structure. Groups of multi-stem hazel within group. No woodland edge habitat on boundary with building zone.	No active management recorded. Fair to good vitality.	No public access, fencing surrounds area	None observed	Low – occasional Oak sapling	Rabbit proof fencing surrounds plot. Tree stakes and ties still attached.	Close spacing between trees/shrubs restricting crown formations. Relatively uniform height throughout. Limited understorey vegetation due to dense canopy cover. Lapsed hedgerow to north of group along highway. High number of dead elms. Narrow plot. Tree ties restricting growth in places. Landscape function – Shelter belt
G016E	Trees: Common Ash, Common Oak, Cherry, Beech, Lime Shrubs: Hazel, Hawthorn	Young to semi-mature	Growing as a broadly rectangular plot on level ground. Planted plot with no obvious rows. Random planting configuration with 1-2m spacings between trees. Limited variation in vertical structure. Groups of multi-stem hazel within group. No woodland edge habitat on boundary with building zone.	No active management recorded. Fair to good vitality.	No public access, fencing surrounds area	None observed	Low – occasional Oak sapling	Rabbit proof fencing surrounds plot. Tree stakes and ties still attached.	Close spacing between trees/shrubs restricting crown formations. Relatively uniform height throughout. Limited understorey vegetation due to dense canopy cover. Lapsed hedgerow to north of group along highway. High number of dead elms. Narrow plot. Tree ties restricting growth in places. Landscape function – Shelter belt

Group reference	Species	Age	Current layout and spacing	Current management & vitality	Public access	Invasive Species	Amount of regeneration	Current protection	Current observations, issues and opportunities
G002	Trees: Sycamore, Elm Shrubs: Elder	Young to mature	Informal group of primarily Elm. Dry ditch to north. Sloped banks to south. Average spacing 5m between trees.	Historic management of cut stems on Elm recorded and trimming back of vegetation from highway infrastructure to north. Fair to good vitality.	Public footpath runs parallel to north.	Dense ivy ground cover	Medium – largely self-sown Elm	No guards or protection in place	Potentially outside of site ownership. Limited species diversity. Dry ditch to north of group. Dense ivy clad stems in places. Majority of trees are Elm, with Dutch Elm Disease present within locality. <u>Landscape function – Shelter belt</u>
G003 & G003A	Trees: Common Ash, Elm Shrubs: Hawthorn, Blackthorn, Elder	Young to mature	Lapsed hedgerow running along the north boundary of the site. Not continuous, occasional gaps. Intermittent standard trees present. Successional growth from blackthorn scrub. Largely Elm and hawthorn.	Historic management of cut stems on Elm recorded and trimming back of vegetation from highway infrastructure to north. Fair vitality, standing dead stems in places with some collapsed.	Public footpath runs parallel to north.	Pockets of bramble and areas of Blackthorn scrub in places	Medium – largely self-sown Elm	No guards or protection in place	Potentially outside of site ownership. Limited species diversity. Collapsed and dead stems in places through neglect, windthrow and competition for light, inducing drawn and unbalanced crowns. Standard trees limited. Gaps in places from collapsed stems. Dry ditch to south of group in places. Dense ivy clad stems in places and covering ground. Majority of trees are Elm, with Dutch Elm Disease present within group. <u>Landscape function – hedgerow and occasional standard trees</u>
G024A	Trees: Common Oak, Common Ash, Aspen, Cherry, Field Maple, Scots Pine Shrubs: Hawthorn, Hazel, Elder, Guelder Rose, Privet, Dog Rose, Dogwood, Blackthorn	Young to semi-mature	Growing on earth mound, rectangular shape Average 1.5-2m spacings between rows and plants. No management recorded, stock now leggy and drawn. Groups of multi-stem hazel and other pockets of odd-numbered shrubs. Some variation in vertical structure. Areas of shrubs on boundaries.	No recent management record. Good vitality	No	Dense pockets of Blackthorn and Bramble	Medium – occasional self-sown Elder, blackthorn	Tree/shrub guards still attached to majority of stock	Tree/shrub guards restricting growth in places. Close spacing between trees/shrubs restricting crown formations. Aspen present which can outcompete with more preferable species. <u>Landscape function – Shelter belt</u>
G019	Trees: Common Oak, Beech, Lime, Horse Chestnut	Young to semi-mature	Growing within maintained grass area. Intermittent standard trees.	No recent management recorded. Primarily in good vitality	Unrestricted access	None recorded	None recorded	None recorded	Tree 1691 – horse chestnut in decline due to Bleeding canker – need felling. Close spacing between trees/shrubs restricting crown formations. Additional low level planting to reinforce screen. <u>Landscape function – standard tree group</u>

Group reference	Species	Age	Current layout and spacing	Current management & vitality	Public access	Invasive Species	Amount of regeneration	Current protection	Current observations, issues and opportunities
G041	Trees: Field Maple, Elm, Ash, Alder Shrubs: Hawthorn, Elder, Hazel, Blackthorn	Young to early-mature	Boundary hedgerow & occasional trees. Predominantly self-set elm. Southside cut back for cycle way clearance. Fair vitality, deadwood in crowns. Gaps in line.	Southside cut in places opposite footpath	Unrestricted access	Dense ivy and bramble	Medium – occasional self-sown Elder, blackthorn	Tree/shrub guards still attached to some planted stock on north side of footpath	Limited species diversity. Collapsed and dead stems in places through neglect, windthrow and competition for light inducing drawn and unbalanced crowns. Standard trees limited. Gaps in places from collapsed stems. Dense ivy clad stems in places. Landscape function – Hedgerow with standard trees
G090	Trees: Crab Apple Shrubs: Hawthorn, Elder	Semi-mature – mature	Old field boundary hedgerow. 5xindividual crab apple trees-crown lifted to 3m. Decay entry points, old branch wounds. Fair to good vitality.	Hedgerow topped at 2m. Western extents not topped. Gaps in places. Ivy clad stems.	Unrestricted access	Dense ivy in places	Low	None identified	Hedgerow to receive consistent management along its entire extents to prevent it from becoming leggy and drawn. Landscape function – hedgerow
G105	Trees: Silver Birch, Hawthorn Scots Pine, Lime, Whitebeam.	Young to semi-mature	Boundary tree planting. No understorey. Average spacing 3m.	No current management recorded	Unrestricted access	Ivy in places	Low	None identified	Excavation works to north for highway improvements. Boundary vegetation removed to north from highway works. Drawn stems given close spacing between trees. No shrub understorey. Landscape function – standard tree group

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4.2 General management prescriptions

4.2.1 There are general management prescriptions that are applicable to all groups and these are as follows:

- Thinning of those that are failing to thrive to enable more space within the woodland groups for the remaining trees/shrubs to continue to develop – thinning to target removal of dangerous trees and the shorter-lived tree species or those that will respond to coppice management, i.e. the felling of trees/shrubs to above ground level to enable them to regenerate.
- Removal of tree stakes, guards and ties that are currently restricting growth;
- New planting to enhance species diversity and improve screen functions over the long term;
- Hedgerow management to return lapsed hedgerows back to continuous screens and to improve their density at lower levels by cutting their tops to promote lateral spread;
- Improve habitat value within each group.

4.3 General management objectives

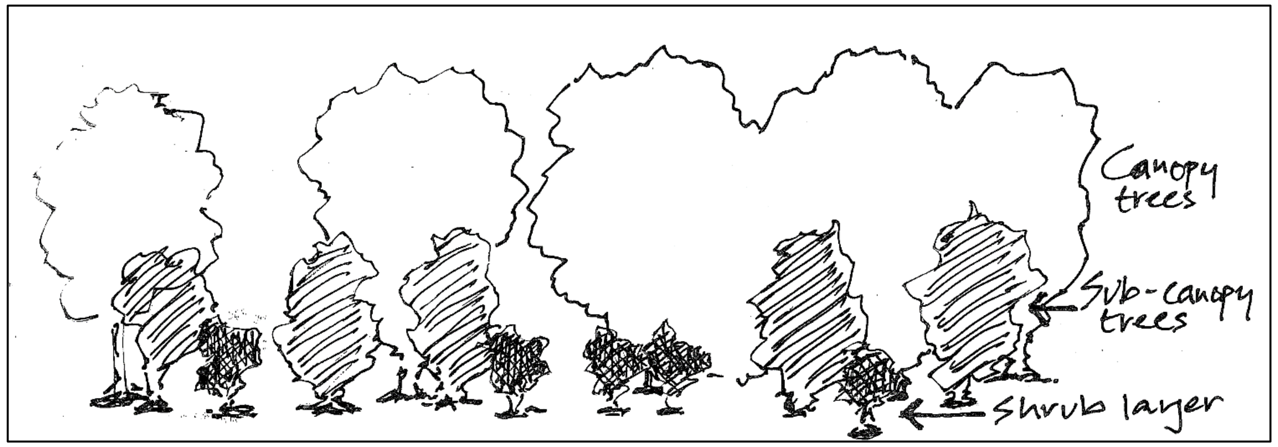
4.3.1 There are general management objectives in order to meet the prescriptions above that are applicable to all groups:

- Reduce the total percentage of single species dominance to below 50% of tree population, through targeted thinning and replacement of felled trees with alternative species.
- Dead and dying trees play an integral role in the functioning and productivity of woodland group ecosystems. As such the objective shall be for a minimum of six fallen and six standing pieces of deadwood per group, spread throughout the group. Any trees felled for the works can be processed and retained as a deadwood source, e.g. deadwood piles. Leave deadwood in canopies, especially with rot holes for nesting or roosting habitat, or fix sections of deadwood in canopies.
- The creation of woodland edge habitat shall be undertaken on the sides of the groups adjacent to the building zones where they do not already exist. Woodland edges can be planted to allow widths of natural regeneration to occur. A minimum of 5m in width is recommended with a minimum of 50% of the side of the woodland adjacent to the building zone used to create new woodland edge habitat, if a continuous line is not adopted. This will create a scalloped edge to the woodland on the development side. If they are planted then a layout of five staggered rows is typical. Evergreen trees or shrubs shall be included to woodland edge planting as they provide year-round shelter. Scalloping the woodland edges will maximise woodland edge habitat.
- Veteranisation of existing trees. A veteran tree is one with habitat features such as wounds or decay. A veteran may be a comparatively young tree with a small girth in contrast to an ancient tree, but with key characteristics, e.g. scars of age including decay or hollowing trunk, significant amounts of deadwood, etc. The veteranisation of existing trees is the practice of inducing decline in a tree using chainsaws or handsaws to promote veteran tree features such as deadwood, rot holes and hollowing stems. The objective shall be 3-6 veteran trees within suitable groups.
- Areas of dense bramble, ivy and Blackthorn scrub can outcompete the more beneficial flora or shrubs. Management shall be aimed at stopping their spread by scrub control or hand pulling. Applications of herbicide on cut stumps shall be undertaken where necessary to prevent regeneration. It must be noted that pockets of bramble are beneficial for wildlife, as such certain sections shall be retained as agreed through consultation with an ecologist.
- Blocks of new shrub planting shall be undertaken in suitable plots to enhance screen functions and where appropriate achieve a multi-layered age and height structure with no single age classification above 50%. Planting shall only be native trees and shrubs. Native trees of local provenance are genetically adapted to the local climate and environmental conditions. Planting non-local provenance trees could upset the fine balance between native trees and the wildlife they support, e.g. through flowering or seeding at different times.

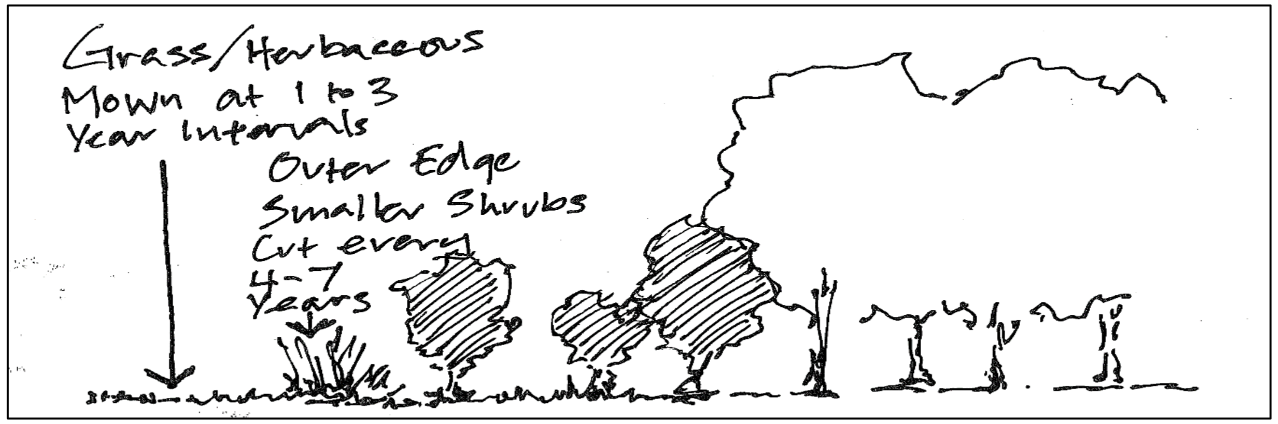
4.4 Woodland edge habitat and supplementary planting

4.4.1 The aim of any planted woodland edge habitat and new supplementary planting is to establish irregularly spaced and sized groups of shrubs and potentially small trees along or close to the edges of the existing groups to improve species diversity and enhance screening functions.

4.4.2 An idealised woodland edge would provide a gradual progression from shrubs through to canopy trees as illustrated in the sketch below. This tiered approach also serves to provide buffering to winds that can minimise potential windthrow occurrences for any previously sheltered trees that may be revealed during any prescribed thinning operations. The planting should take a more natural layout targeting scalloped edges with irregular numbers of different tree/shrubs species, evergreen species should also be used to improve the year round screen functions of the groups, e.g. Holly and Yew.



4.4.3 The size and extent of any new planting will need to be designed specifically for each plot. As mentioned a 5m width of woodland edge habitat is recommended with the subsequent future management of the planting possibly taking the form of that described on the sketch below where there is sufficient space:


Grass/Herbaceous
Mown at 1 to 3
Year intervals
Outer Edge
Smaller Shrubs
Cut every
4-7
Years

5. Specific objectives

5.1 Specific objectives

5.1.1 The plot specific objectives are as follows:

Actions	
1.1	Confirmation of legal compliance for any works including felling licence and protected species requirements.
1.2	Remove tree stakes, ties and guards from trees/shrubs that no longer require them. Re-fix where they are still required for support.
1.3	Carry out thinning operations. Favouring the retention of Oak. Target felling of Cherry and Aspen the shorter lived species or those species that will coppice, e.g. Hazel, Field Maple and Ash, or those in poor condition. Implement veteranisation of certain trees to be thinned and create dead wood habitat as direct by an ecologist.
1.5	Implement management practices in line with County Wildlife Management plan, favouring retention of scrub communities within appropriate groups.
1.6	Implement scrub clearance of pockets of bramble, ivy and blackthorn & self-sown sycamore with appropriate groups.
1.8	Design and plant woodland edge adjacent to building zones. Planting design to be agreed.
1.11	Implement hedgerow management by topping between 1.5--5m and flailing sides and undertaking supplementary planting where appropriate
1.13	Implement aftercare maintenance for all newly planted stock for a minimum of 5 years to ensure successful establishment
2.1	Implement coppicing of previously felled trees and shrubs whose stumps were not treated with herbicide.

5.2 Monitoring

5.2.1 A system of monitoring is important to assess the efficiency, effectiveness and impact of any management objectives or actions implemented. The monitoring system shall be designed in line with the objectives identified within this management plan.

5.2.2 In assessing monitoring requirements it is advisable to follow the checklist below in order to promote effective results, if the answer is no for any of the questions then undertake a review of the procedures.

Table 5.1 Monitoring checklist

Question	Y/N
Has the monitoring been undertaken at the optimal times of year for the subject matter?	
Do the surveyors have the appropriate expertise to undertake the monitoring required for the data collection sheet?	
Has training been provided for less expert surveyors as appropriate for the subject matter?	
Have the monitoring limitations been recognised? This may include: sub-optimal survey periods, failure to survey whole site etc.?	
Has the monitoring been supported by appropriate and accurate aerial imagery, mapping information or photographs taken at set locations marked on the map information?	

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6. Development offsets

6.1 General

6.1.1 One of the aims of this plan was to establish the proximity of canopy tree species within the boundary tree groups that are growing adjacent to proposed building zones within the site. The canopy species selected are those that have the capacity to be long-lived trees, barring the arrival of any pests and diseases that may influence their longevity. The species recorded are Common Oak, Common Ash, Lime and Alder.

6.1.2 When assessing suitable offsets it is the opinion of the Arboriculturist that the growth potential of the trees within the context of these boundary groups is not the same as those which are open grown standard trees. This is due to competition with neighbouring trees for sunlight, space and nutrients, which can stunt growth or indeed induce tall and drawn forms, rather than large open canopied trees which is why 10m is deemed adequate for canopy trees within the larger groups.

6.1.3 Whilst, the principal role of the woodland groups is to provide perimeter enclosure and screening, rather than as individual standard specimen trees in the landscape, occasional individual trees within some of the larger groups, specifically those along the southern edge, will be assessed for the creation and subsequent preservation of 'legacy' trees. These works will not be carried out within all groups as the creation of sufficient space to enable the trees to fully develop will diminish the screen functions of the narrower groups which is one of the main concerns of the Local Authority going forward.

6.2 Tree tag table and offsets

6.2.1 The table below captures all the tree tags and their associated species. It also recommends reasonable offsets from building zones from these canopy trees using the previously agreed offsets with the Local Authority as guidance and using professional opinion:

Plot	Species	Recommended offset
W1 1937-1950	1937-1939, 1942, 1943, 1945, 1946 & 1950 – Common Ash 1940 & 1941 – Common Oak 1944, 1947, 1948 & 1949 – Common Alder	10m
W2 1926-1936	1926-1929, 1931, 1932 & 1936 – Common Ash 1930 & 1935 – Common Alder 1934 – Common Oak	5m 15m for legacy trees – 3no. trees to be identified
W3A 1901-1913	1901-1903, 1905-1908, 1912 & 1913 – Common Ash 1904, 1909-1911 – Common Oak	10m 15m for legacy trees – 3no. trees to be identified
W3B 1914-1925	1914-1924 – Common Ash 1925 – Common Oak	5m 15m for legacy trees – 3no. trees to be identified
W4A 1951-1953	1951 & 1953 – Hawthorn 1952-missing tag	No canopy trees within this group. An offset of a minimum of 5m from the edge of the group should be allowed in order to enable sufficient space for future management and any new planting
W4B 1954-1960	1954, 1956-1960 – Sycamore 1955 – Common Ash	An offset of a minimum of 5m from the edge of the group should be allowed in order to enable sufficient space for future management and any new planting.
W4C 1961-1963	1961 – Blackthorn 1962 – Common Ash 1963 – Horse Chestnut	An offset of a minimum of 5m from the edge of the group should be allowed in order to enable sufficient space for future management and any new planting.
G116 1965-1968	1965 & 1967 – Common Ash 1966 & 1968 – Common Oak	10m
G016A 1969-1985	1969, 1970, 1982 & 1985 – Common Oak 1971-1975, 1977, 1979-1981 & 1983 – Common Ash 1976, 1978 & 1984 - Lime	10m
G016B 1986-1992	1986 – Common Oak 1988-1992 – Common Ash 1987 – Lime	10m
G016C 1993-2000	1993, 1995, 1998-200 – Common Oak 1994 & 1997 – Common Ash 1996 – Lime	10m
G016D 1897-1900	1897-1900 – Common Ash	10m
G016E 1888-1896	1896, 1894-1890 & 1888 – Common Ash 1895 & 1889 – Common Oak	10m
G024A 1887-1870	1887-1885, 1883, 1876-1874, 1871 & 1870 – Common Ash 1884, 1882, 1881, 1879, 1877, 1873 & 1872 – Common Oak 1880 & 1878 - Lime	10m
G105	Mixed	10m
G019	Mixed	10m
G041	Mixed	5m
G090	Mixed	5m

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Appendix A: Site survey photographs

	Wood W3A looking north-east, diagonal row of oaks
	Young multi-stemmed hazel in Wood W3B (western section)

	Wood W2 – young growth with tubing/stakes still in place
	Wood W4A - interior

	Wood W4B – sycamore colonising wood edge
	Wood W4C, showing clustering elm on left side, with single ash specimen beyond and highway planting to west

	Woodland group G116 looking north-east, showing space available at east end for additional planting and space to south for woodland edge planting
	Woodland group G016A (western section), looking west

	Woodland group G016B (section to west of J.J. Thomson Avenue) looking north-west, showing space available for additional planting
	Woodland group G016C (section to west of J.J. Thomson Avenue) – interior view

	Woodland group G016D&E (eastern section) – front view looking north-west from car park
	Woodland group G024A – front view looking north-east from car park

	Woodland group G024A – interior

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Appendix B: References & Bibliography

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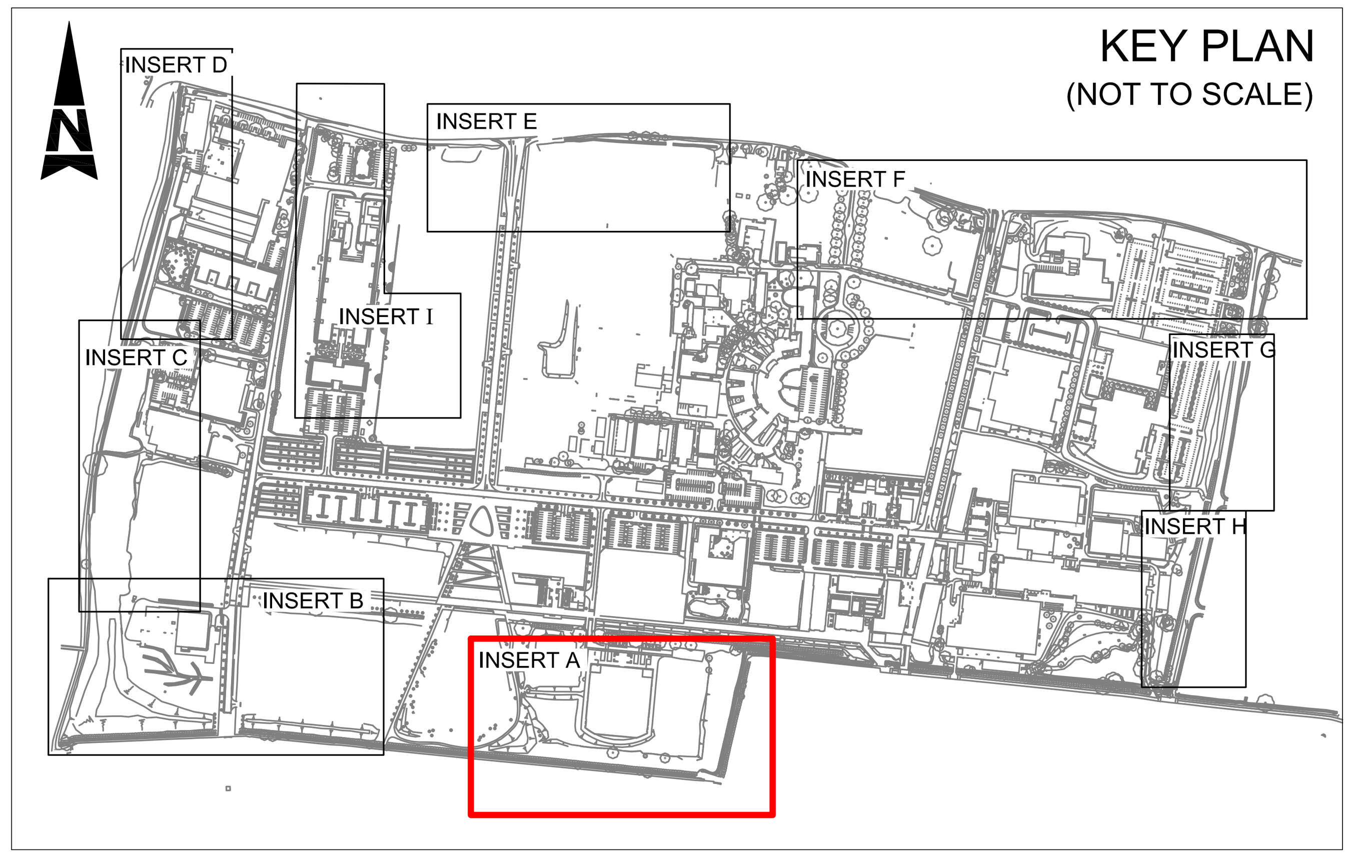
Appendix C Detailed Figures



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000	CATEGORY U TREE + TREE REF.
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W1	WOODLAND GROUP REFERENCE (COLOUR RELATES TO BS CATEGORIES AS FOR INDIVIDUAL TREES AS SHOWN ABOVE)
	ROOT PROTECTION AREA
	EXTENT OF OUTER EDGE TREE STEMS OF WOODLAND/ GROUPS
	5M BUFFER FROM TREE STEM TO BUILDING EDGE
	8M BUFFER FROM TREE STEM TO BUILDING EDGE
	10M BUFFER FROM TREE STEM TO BUILDING EDGE
	15M BUFFER FROM TREE STEM TO BUILDING EDGE

Stat	Purpose of Issue	Date	Auth
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Rev	Description	By	Date	Chk'd	Auth
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B	UPDATE BUFFER ZONES	BC	26/04/17	TD	TD
A	UPDATE BUFFER ZONES	BC	16/02/17	TD	TD
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Project
WEST CAMBRIDGE MASTERPLAN (EIA)

Title
WOODLAND MANAGEMENT PLAN
FIGURE 2.1
ENLARGEMENT A

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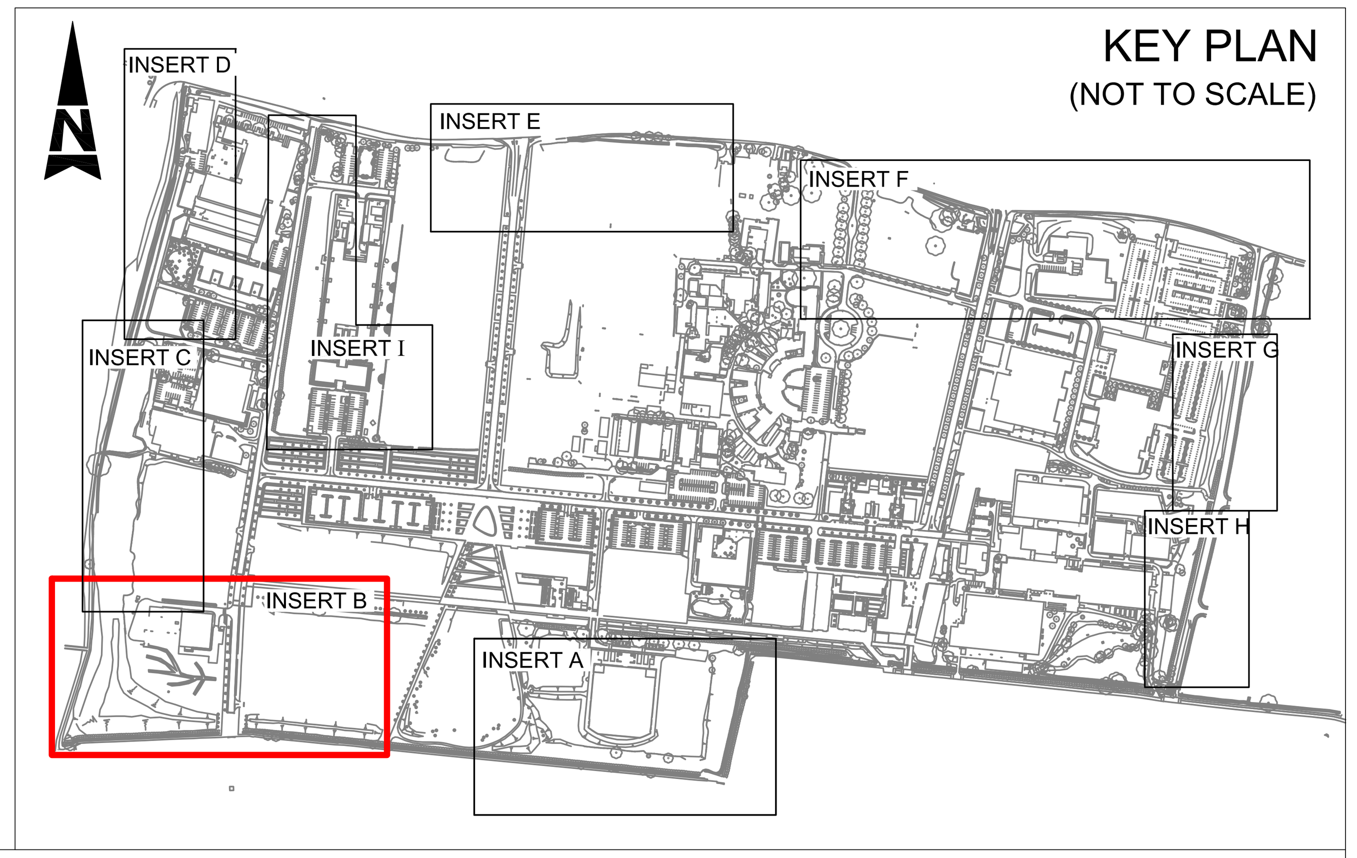

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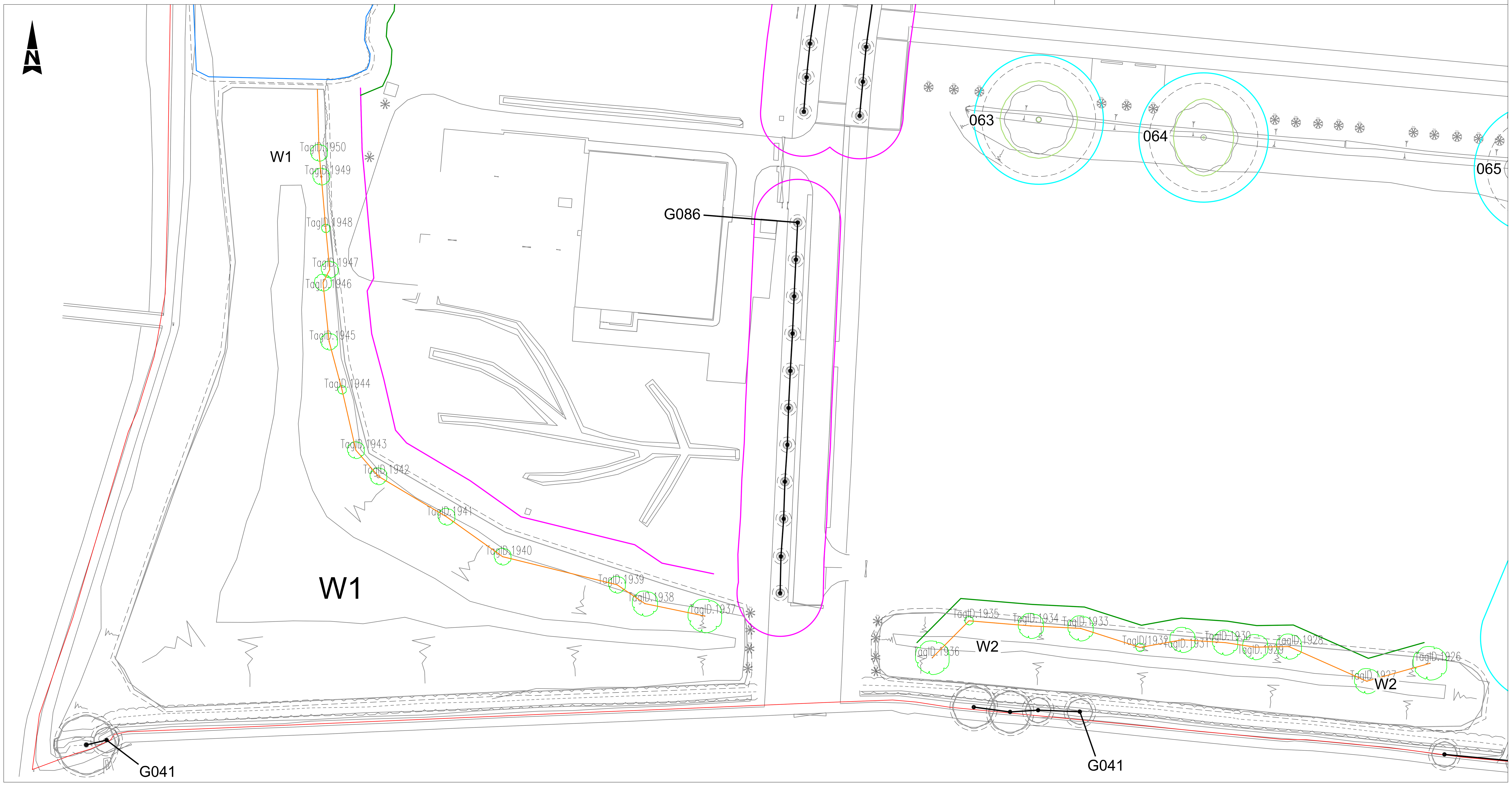

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ROOT PROTECTION AREA

EXTENT OF OUTER EDGE TREE STEMS OF WOODLAND/ GROUPS

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FIGURE 2.1
ENLARGEMENT B

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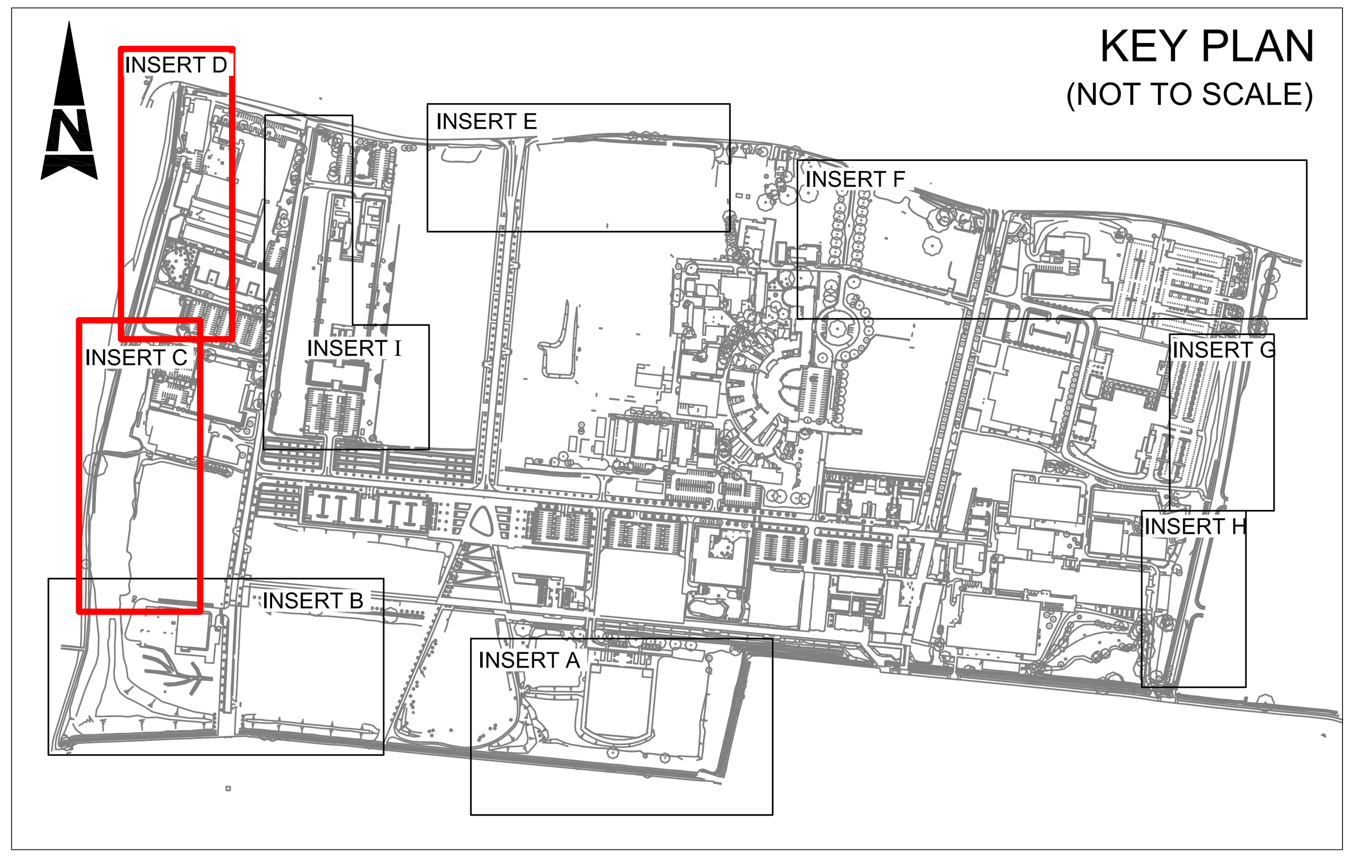

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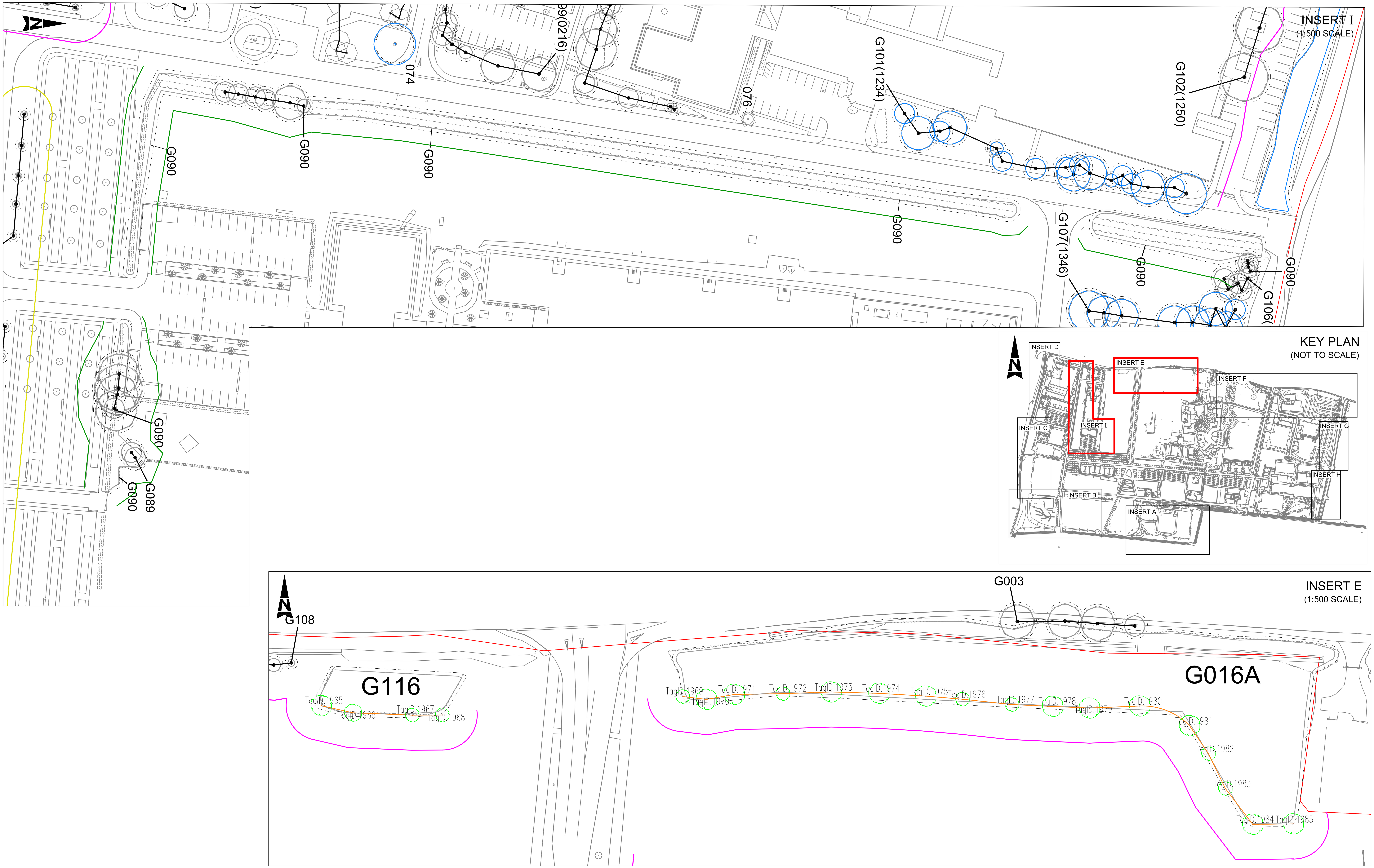

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ENLARGEMENT E& I

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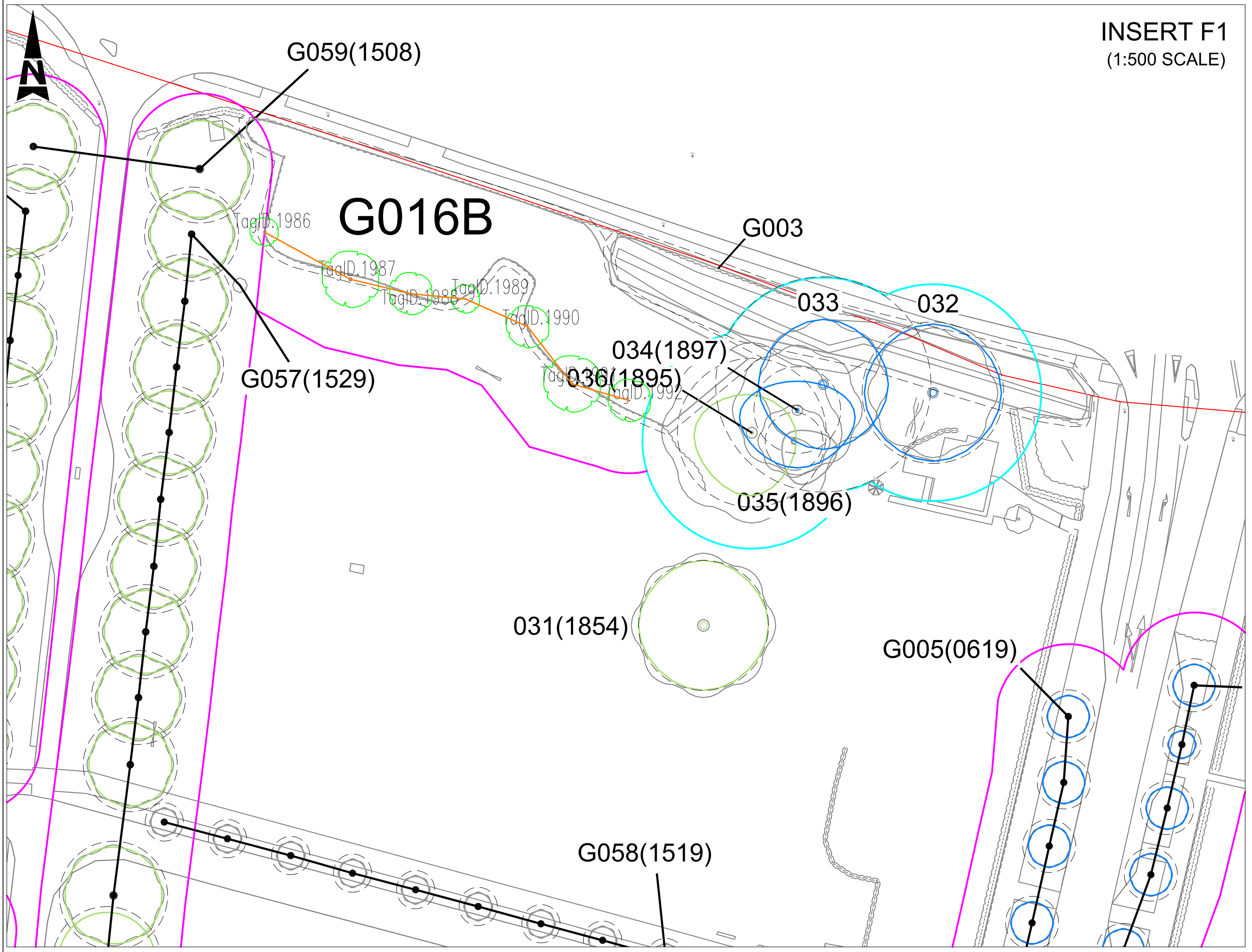

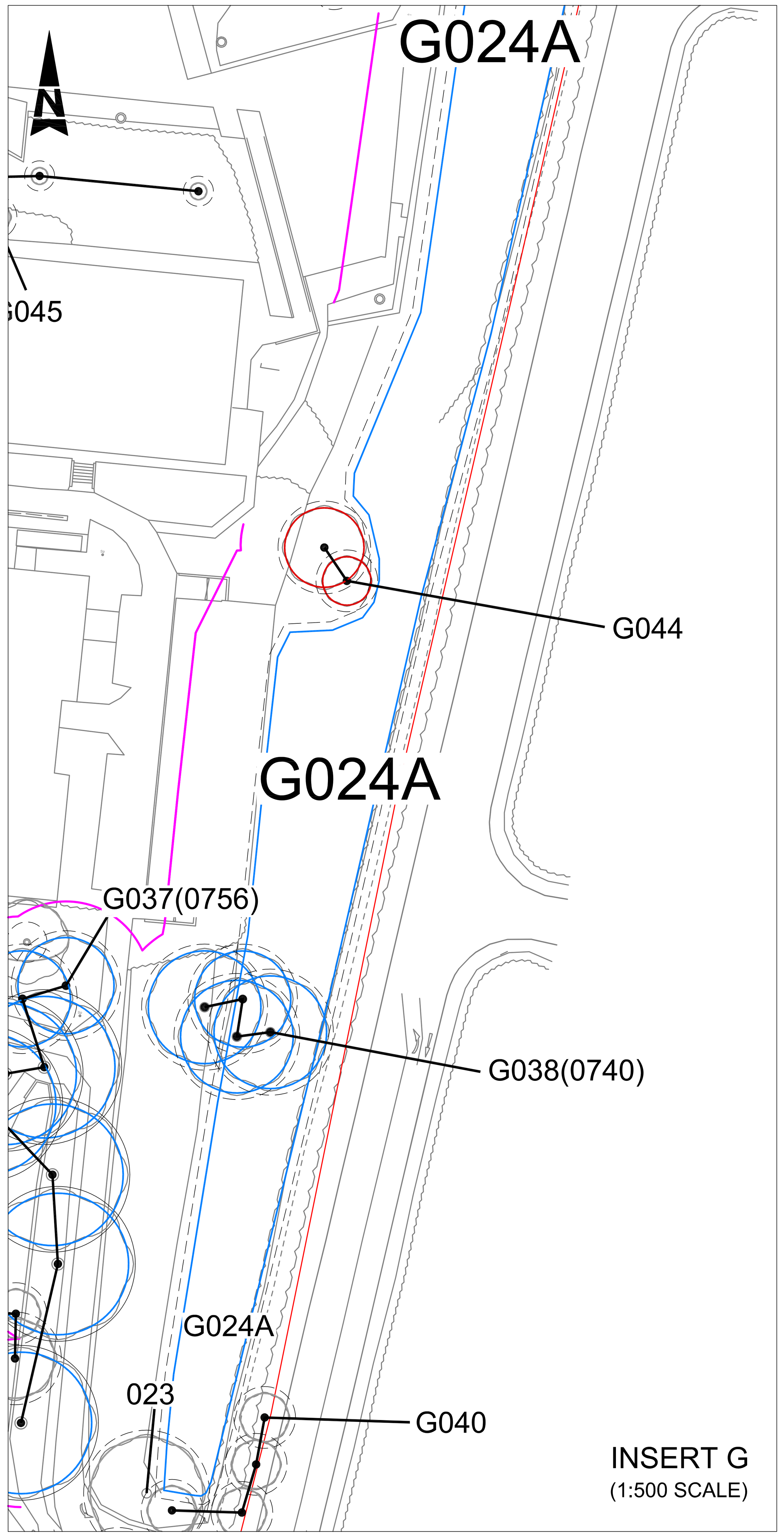

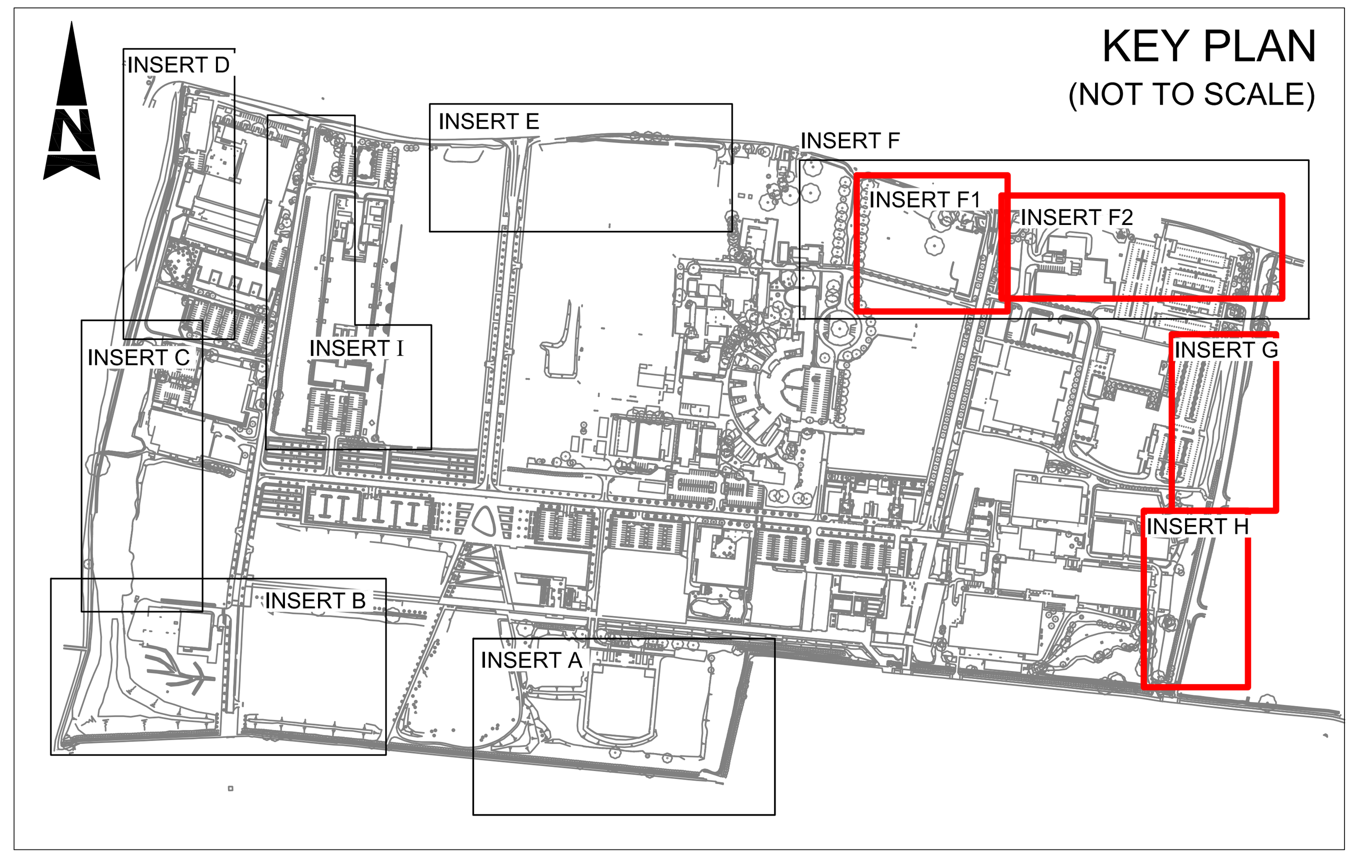

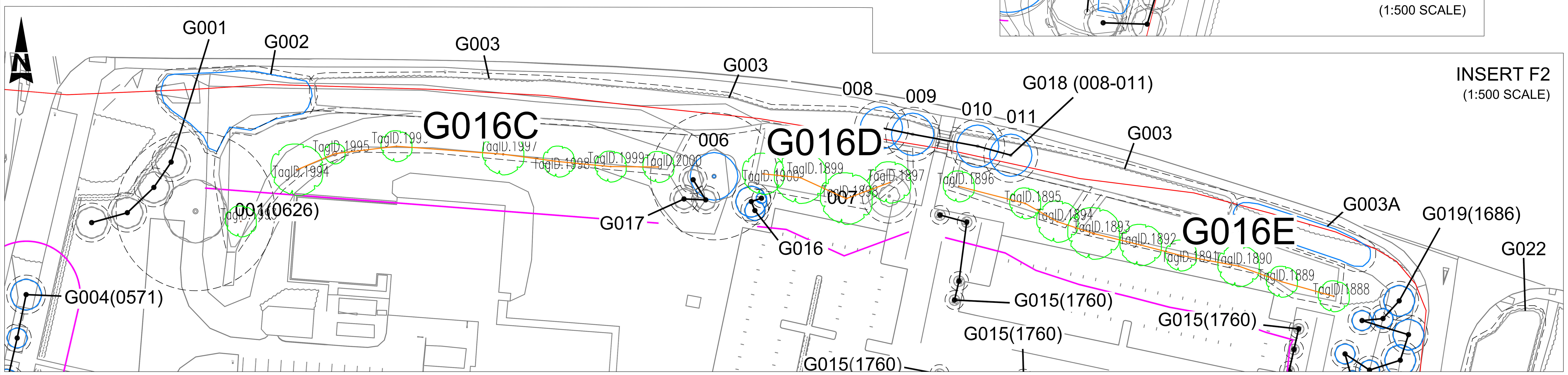

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ENLARGEMENT F, G & H

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Appendix 9.1 Employment calculations

Maximum employment calculations

Construction phase employment

Construction cost of the Proposed Development has been estimated at £1.8 billion. Using an average construction turnover per employee of £225,000 (based on a sample of 30 major UK construction companies), the Proposed Development creates 8,000 construction person year jobs, an equivalent of 800 FTE construction jobs over the Development's 15 year construction period.

Assuming a moderate composite multiplier of 1.25 at the local level and 1.50 at the regional level (as recommended by the HCA Additionality Guide 2014), the construction of the Proposed Development could indirectly support a further 200 jobs locally and 400 jobs regionally.

Operational phase jobs on Site

The total number of jobs on Site after completion of the Proposed Development in 2031 was calculated using total proposed floorspace figures provided by AECOM, average employment densities from the Employment Densities Guide 2nd Edition (HCA) and guidance from AECOM and Creative Places (see Table A9.1.1). All jobs referred to in this report are Full Time Equivalent (FTE) jobs. The total number of FTE jobs on Site is calculated to be 13,994.

This must be considered alongside the estimated 4,350 FTE jobs at the adjacent North West Cambridge scheme upon completion in 2026 (source: NWC EIA, Table 5.14, page 5-17).

The total employment floorspace of the West Cambridge Site when the Proposed Development is complete (existing + proposed net additional floorspace) will be 500,280m^2, comprising: 210,386 m^2 commercial, 257,909 m^2 academic, 1,000 m^2 retail/food drink, 3,150 m^2 nursery, 10,160 m^2 assembly and leisure, 7,675 m^2 ancillary and 10,000 m^2 residential.

To calculate commercial, retail and academic employment, it was first assumed that the floorspace figures given were Gross External Area (GEA) and that this represents 120% of Net Internal Area (NIA) i.e. the area supporting employment. The NIA for commercial floorspace is therefore 175,322 m^2, for retail/food & drink 833 m^2 and for academic 214,924 m^2.

It was assumed that 99% of the commercial NIA (173,568 m^2) will be office, dry lab and workshop uses with respective employment densities of 17 m^2, 25 m^2 and 35 m^2 per FTE (based upon AECOM and Creative Places guidance). The floorspace was assumed to be split between the uses as follows: 80% office (138,855 m^2), 10% dry lab and 10% workshop (17,357 m^2 each). The three uses together support 9,358 jobs. It should be noted that this assumption represents the maximum expected office use class floorspace. It may be the case that a higher proportion of the commercial floorspace is dry lab/workshop use. If so, the level of employment will be lower.

It is assumed that 98% of the academic NIA (210,626m^2) will be used for academic purposes. Based on AECOM guidance regarding the University of Cambridge's employment densities for academic floorspace, an employment density of 50 m^2 per FTE was used for the academic floorspace NIA of 210,626m^2. Academic jobs on Site will therefore number 4,213.

For retail/food & drink employment, the remaining 1% of the commercial NIA (1,753m^2) and 2% of the academic NIA (4,298m^2) was assumed to be retail/food & drink shared facilities within academic and commercial space. In addition to the 833 m^2 specified retail/food & drink floorspace, this brings total retail/food & drink NIA to 6,885 m^2. (Note: the revised description of development for which planning permission is sought includes up to 4,000 m^2 (GEA) of 'stand alone' retail / food & drink (Use Classes A1-A5). The Original Planning Application description of development identified up to 1,000 m^2 (GEA) of floorspace in Use Classes A1-A5. This amendment has been made to allow a greater proportion of the retail/food & drink floorspace to be delivered through 'stand alone' facilities (such as the Shared Facilities Hub), rather than as accommodation within predominantly academic (Class D1) or commercial research (Class B1(b) facilities. This amendment does not change the assumption that in total around 6,885 m^2 NIA of retail/food & drink would be provided on site, either as stand alone facilities or as ancillary space. An Employment density of 18 m^2 per FTE would apply to both types of provision, which is based upon Employment Densities Guide 2nd Edition densities for high street (19), food superstores (17), and restaurants & cafes (18). This supports 383 jobs. This total number of retail/food & drink jobs does not change as a result of the amendment to the description of development in the revised description of development. The amendment does not change the assumption about the total amount of retail/food & drink floorspace to be provided on site – 6,885 m^2 (NIA) during the operational phase, it merely enables a greater proportion of this space to be provided as stand alone accommodation (Class A1-A5) than was the case in the Original Planning Application.

Following discussion with AECOM, provisional figures of 20 nursery and 20 assembly and leisure jobs have been used rather than calculating based upon floorspace. Ancillary floorspace is expected to be used for an energy centre with negligible employment creation, thus assumed to be zero. These figures are to be refined at a later stage. The existing residential floorspace (10,000 m^2 GEA, 8,333 m^2 NIA) on site is not expected to generate employment opportunities.

Operational phase net additional employment benefits

The net additional job creation of the Proposed Development is estimated to be 6,600 FTE jobs at the local level and 8,100 FTE jobs at the regional level.

The total number of jobs to be created on site by the Proposed Development excluding deadweight was calculated at 6,367 office-based, 541 dry lab, 387 workshop, 308 retail, and 2,526 academic, using the proposed (rather than existing) floorspace figures and above assumptions regarding floorspace uses and employment density. The 20 assembly and leisure jobs are eliminated as deadweight, whilst the 20 nursery jobs were excluded from calculations because their numbers are too low to have any significant leakage, displacement or economic multiplier effects.

The net employment benefits at the local and regional levels were calculated by incorporating leakage, displacement, and economic multiplier effects. The HCA ready-reckoners (HCA Additionality Guide 2014) were used to quantify these effects, with assessment of Cambridge's economic characteristics and baseline informing the selection of each ready-reckoner, as follows.

Leakage

Leakage is estimated as the number or proportion of outputs that will benefit those outside the Proposed Development's target area.

For office, dry lab and workshop jobs, the high quality of jobs is usually likely to lead to higher levels of leakage as it provides incentive for people from outside the local area to commute to access employment opportunities. Evidence suggests that this is indeed the case in the Cambridge area. However, given the high level of qualification of residents of Cambridge and South Cambridgeshire - far exceeding the regional average - and resultant significant pool of suitable potential employees, it is assumed that a significant number of jobs created will be taken up by those residing within the two local authorities, mitigating some of the leakage effects. This employment leakage is therefore expected to be moderate (25% by the HCA ready-reckoners).

The leakage for office, dry lab and workshop jobs on the regional level is likely to be low (10% by the HCA ready-reckoners), since commuting from beyond the region is not expected to be very prevalent.

For retail, leakages are expected to be low on the local level (10%) and negligible (0%) on the regional level. This is because of the low value nature of these jobs which make long commutes highly unlikely.

For academic jobs, leakages on the local and regional levels are expected to be very low (10% and 5% respectively), because the vast majority will be taken up by those based locally at the University of Cambridge.

Displacement

Displacement would arise if businesses located in the Proposed Development were to employ people currently employed by firms elsewhere in the area. It follows that these jobs would not be additional jobs but rather displaced from elsewhere in the area.

For office jobs the displacement effect is assumed to be low (25% on the local level and 30% on the regional level) because a large proportion of businesses located on the Proposed Development are to be start-ups and new firms rather than firms previously based elsewhere in the local or regional area. Whilst local businesses experience a significant level of competition within the cluster which would ordinarily result in displacement, the particularly large and growing pool of skilled labour associated with the University is likely to go a considerable way towards eliminating this effect.

For retail, the expected local, convenience nature of the businesses established make it unlikely that significant numbers of other jobs will be displaced. The displacement is therefore assumed to be low – 25% at both the local and regional levels.

For academic jobs, the majority of floorspace is to be used to rehouse pre-existing academic departments. A high level of displacement is assumed – 65% for the local and regional levels.

Economic multiplier

Economic multiplier effects refer to knock-on effects within the local economy by which the economic impact of a development is multiplied. In accordance with the HCA Additionality Guide 2014, composite multipliers are assumed to be 1.29 at a local level and 1.44 at a regional level for office development. The same assumption was used for academic jobs, because of the supply chain linkages required for scientific research.

For retail jobs, the HCA recommends lower multipliers, of 1.21 at the local level and 1.38 at the regional level.

Following these assumptions, the leakages and displacement were deducted from the total number of jobs supported by the proposed floorspace, and this figure was put through the multiplier. The total employment figures have been rounded to the nearest 100 FTEs. The process and results are shown in Table A9.1.2 – Table A9.1.4.

Table A9.1.1 Operational phase jobs on Site

	Commercial - Office	Commercial - Dry lab	Commercial - Workshop	Retail/food & drink	Academic	Nursery	Assembly and leisure	Ancillary	Residential
Proposed floorspace (m2)	210,386	210,386	210,386	1,000	257,909	N/A	N/A	N/A	10,000
NIA conversion (m2)	175,321	175,321	175,321	833	214,924	N/A	N/A	N/A	8,333
NIA adjusted for use (m2)	138,855 1	17,3572	17,3572	6,885	210,626 4	N/A	N/A	N/A	c.8,333
Employment density (m2 per FTE)	17	25	35	18	50	N/A	N/A	N/A	N/A
Total jobs (FTE)	**8,168**	**694**	**496**	**383**	**4,213**	**20**	**20**	**0**	**0**

1 – 80% of the 99% of total commercial NIA, with remaining 1% designated as ancillary retail/food & drink
2 – 10% of the 99% of total commercial NIA, with remaining 1% designated as ancillary retail/food & drink
3 – Includes 1% of commercial NIA and 2% academic NIA as shared facilities ancillary to main use
4 – 98% of total academic NIA, with remaining 2% designated as ancillary retail/food & drink

Table A9.1.2 Net additional office, dry lab and workshop jobs

Office, dry lab and workshop FTE jobs	Local	Regional
Gross direct jobs	7,294	7,294
Leakage level	25%	10%
Leakage quantity	1,824	729
Jobs after leakage	5,471	6,565
Displacement level	25%	30%
Displacement quantity	1,368	1,969
Jobs after displacement	4,103	4,595
Economic multiplier	1.29	1.44
Net additional jobs	5,293	6,617
Net additional jobs (rounded)	5,300	6,600

Table A9.1.3 Net additional retail jobs

Retail FTE jobs	Local	Regional
Gross direct jobs	308	308
Leakage level	10%	0%
Leakage quantity	31	0
Jobs after leakage	278	308
Displacement level	25%	25%
Displacement quantity	69	77
Jobs after displacement	208	231
Economic multiplier	1.21	1.38
Net additional jobs	252	319
Net additional jobs (rounded)	300	300

Table A9.1.4 Net additional academic jobs

Academic FTE jobs	Local	Regional
Gross direct jobs	2,526	2,526
Leakage level	10%	5%
Leakage quantity	253	126
Jobs after leakage	2,274	2,400
Displacement level	65%	65%
Displacement quantity	1,478	1,560
Jobs after displacement	796	840
Economic multiplier	1.29	1.44
Net additional jobs	1,027	1,210
Net additional jobs (rounded)	1,000	1,200

Minimum employment calculations

Operational phase jobs on Site

The minimum total number of jobs on Site after completion of the Proposed Development in 2031 was calculated using total proposed floorspace figures which replace all proposed commercial floorspace with academic floorspace (retaining existing commercial floorspace), average employment densities from the Employment Densities Guide 2nd Edition (HCA) and guidance from AECOM and Creative Places (see Table A9.1.5). The minimum total number of FTE jobs on Site is calculated to be 9,453. All jobs referred to in this appendix are Full Time Equivalent (FTE) jobs.

Table A9.1.5 Minimum operational phase jobs on Site

	Commercial - Office	Commercial - Dry lab	Commercial - Workshop	Retail/food & drink	Academic	Nursery	Assembly and leisure	Ancillary	Residential
Proposed floorspace adjusted for use (m2)	36,7491	4,5942	4,5942	9,9023	413,457 4	N/A	N/A	N/A	10,000
NIA conversion (m2)	30,624	3,828	3,8282	8,2523	344,548	N/A	N/A	N/A	c.8,333
Employment density (m2 per FTE)	17	25	35	18	50	N/A	N/A	N/A	N/A
Total jobs (FTE)	1,800	200	100	500	6,900	20	20	0	0

1 – 80% of the 99% of total commercial floorspace, with remaining 1% designated as ancillary retail/food & drink

2 – 10% of the 99% of total commercial floorspace, with remaining 1% designated as ancillary retail/food & drink

3 – Includes 1,000sq.m proposed retail floorspace plus 1% of commercial floorspace and 2% academic floorspace as shared facilities ancillary to main use

4 – 98% of total academic NIA, with remaining 2% designated as ancillary retail/food & drink

This must be considered alongside the estimated 4,350 FTE jobs at the adjacent North West Cambridge scheme upon completion in 2026 (source: NWC EIA, Table 5.14, page 5-17).

The total employment floorspace of the West Cambridge Site when the Proposed Development is complete (existing + proposed net additional floorspace) will comprise: 46,400 m² commercial, 421,895 m² academic, 1,000 m² retail/food drink, 3,150 m² nursery, 10,160 m² assembly and leisure, 7,675 m² ancillary and 10,000 m² residential.

It was assumed that 99% of the existing commercial floorspace (45,936 m²) is split between uses as follows: 80% office (36,749 m²), 10% dry lab and 10% workshop (4,594 m² each). It is assumed that 98% of the total proposed academic floorspace (413,457 m²) will be used for academic purposes.

The remaining 1% of the commercial floorspace and 2% of the academic floorspace was assumed to be retail/food & drink shared facilities within academic and commercial space. In addition to the 1,000 m² specified retail/food & drink floorspace, this brings total retail/food & drink floorspace to 9,902 m².

To calculate commercial, retail and academic employment, it was assumed that the floorspace figures given were Gross External Area (GEA) and that this represents 120% of Net Internal Area (NIA) i.e. the area supporting employment. The NIA for commercial floorspace is therefore 38,280 m²: 30,624 m² office and 3,828 m² each for dry lab and workshop. The office, dry lab and workshop uses - with respective employment densities of 17 m², 25 m² and 35 m² per FTE (based upon AECOM and Creative Places guidance) - together support 2,064 jobs.

Based on AECOM guidance regarding the University of Cambridge's employment densities for academic floorspace, an employment density of 50 m² per FTE was used for the academic NIA of 344,548 m². Academic jobs on Site will therefore number 6,891.

For retail employment, an employment density of 18 m² per FTE was used, based upon Employment Densities Guide 2nd Edition densities for high street (19), food superstores (17), and restaurants & cafes (18). The total of 8,252 m² NIA supports 458 jobs.

Following discussion with AECOM, provisional figures of 20 nursery and 20 assembly and leisure jobs have been used rather than calculating based upon floorspace. Ancillary floorspace is expected to be used for an energy centre with negligible employment creation, thus assumed to be zero. These figures are to be refined at a later stage. The existing residential floorspace (10,000 m² GEA, 8,333 m² NIA) on site is not expected to generate employment opportunities.

Operational phase net additional employment benefits

The net additional job creation of the Proposed Development is estimated to be 2,400 FTE jobs at the local level and 2,900 FTE jobs at the regional level.

The total number of jobs to be created on site by the Proposed Development excluding deadweight was calculated at 384 retail and 5,205 academic, using the proposed (rather than existing) floorspace figures and above assumptions regarding floorspace uses and employment density. The 20 assembly and leisure jobs are eliminated as deadweight, whilst the 20 nursery jobs were excluded from calculations because their numbers are too low to have any significant leakage, displacement or economic multiplier effects.

The net employment benefits at the local and regional levels were calculated by incorporating leakage, displacement, and economic multiplier effects. The HCA ready-reckoners (HCA Additionality Guide 2014) were used to quantify these effects, with assessment of Cambridge's economic characteristics and baseline informing the selection of each ready-reckoner, as follows.

Leakage

Leakage is estimated as the number or proportion of outputs that will benefit those outside the Proposed Development's target area.

For retail, leakages are expected to be low on the local level (10%) and negligible (0%) on the regional level. This is because of the low value nature of these jobs which make long commutes highly unlikely.

For academic jobs, leakages on the local and regional levels are expected to be very low (10% and 5% respectively), because the vast majority will be taken up by those based locally at the University of Cambridge.

Displacement

Displacement would arise if businesses located in the Proposed Development were to employ people currently employed by firms elsewhere in the area. It follows that these jobs would not be additional jobs but rather displaced from elsewhere in the area.

For retail, the expected local, convenience nature of the businesses established make it unlikely that significant numbers of other jobs will be displaced. The displacement is therefore assumed to be low – 25% at both the local and regional levels.

For academic jobs, the majority of floorspace is to be used to rehouse pre-existing academic departments. A high level of displacement is assumed – 65% for the local and regional levels.

Economic multiplier

Economic multiplier effects refer to knock-on effects within the local economy by which the economic impact of a development is multiplied. In accordance with the HCA Additionality Guide 2014, composite multipliers are assumed to be 1.29 at a local level and 1.44 at a regional level for academic jobs, because of the supply chain linkages required for scientific research.

For retail jobs, the HCA recommends lower multipliers, of 1.21 at the local level and 1.38 at the regional level.

Following these assumptions, the leakages and displacement were deducted from the total number of jobs supported by the proposed floorspace, and this figure was put through the multiplier. The total employment figures have been rounded to the nearest 100 FTEs. The process and results are shown in Table A9.1.6 – Table A9.1.7.

Table A9.1.6 Net additional retail jobs

Retail FTE jobs	Local	Regional
Gross direct jobs	384	384
Leakage level	10%	0%
Leakage quantity	38	0
Jobs after leakage	346	384
Displacement level	25%	25%
Displacement quantity	86	96
Jobs after displacement	259	288
Economic multiplier	1.21	1.38
Net additional jobs	314	398
Net additional jobs (rounded)	300	400

Table A9.1.7 Net additional academic jobs

Academic FTE jobs	Local	Regional
Gross direct jobs	5,205	5,205
Leakage level	10%	5%
Leakage quantity	520	260
Jobs after leakage	4,684	4,944
Displacement level	65%	65%
Displacement quantity	3,045	3,214
Jobs after displacement	1,639	1,731
Economic multiplier	1.29	1.44
Net additional jobs	2,115	2,492
Net additional jobs (rounded)	2,100	2,500

Appendix 10.1 Construction traffic assessment

11 Construction Traffic

11.1 Introduction

11.1.1 This section identifies the potential peak movements associated with the construction of the Development, and assesses the effects of these movements on the surrounding highway network.

11.2 Assessment of the peak Construction movements

11.2.1 The assessment of the peak construction movements is contained in Appendix 11.1.

11.2.2 The assumed Initial Phase peak Daily Construction traffic flows are summarised in Table 11.1:

Table 11.1 – Peak Daily Construction Movements

Activity	Max Light Vehicle Movts / day			Max Heavy Vehicle Movts / day			Max Total Vehicle Movts / day		
	In	Out	Tot	In	Out	Tot	In	Out	Tot
Earthworks	10	10	20	82	82	164	92	92	184
On-Site Drainage	4	4	8	4	4	8	8	8	16
Carriageway construction	6	6	12	60	60	120	66	66	132
Building construction	10	10	20	0	0	0	10	10	20
Total	**30**	**30**	**60**	**146**	**146**	**292**	**176**	**176**	**352**

11.2.3 These flows are used to assess the impact of the Development on the surrounding highway network.

11.3 Assessment of the peak Construction impact

11.3.1 Of the Construction flows summarised above, only a limited number of car and HGV movements would typically occur during the peak hours: the working hours of most operatives would not coincide with the network peak, and construction processes would be programmed to avoid reliance on deliveries of concrete and bituminous materials during the more congested periods. As there would be only a limited number of Construction movements in the peak hours, no peak hour assessment has been made.

11.3.2 The following assumptions are made with respect to the assignment of these construction trips:

i) no heavy vehicle will be permitted to access the Development from the east through the City of Cambridge – all movements will be from the M11 or A1303;

ii) the operatives are assumed to be resident locally, and would arrive from the following destinations:

- Madingley Road (East) - 30%
- A14 (North West) - 25% (reassigning via Madingley Road)
- M11 (South) - 10%
- A14 (East) - 25% (reassigning via Madingley Road)
- A1303 / A428 - 10%

iii) reflecting the potential supplier locations, it is assumed that material deliveries will arrive from the following destinations:

- Madingley Road (East) - 0%
- A14 (North West) - 35% (reassigning via M11 Junction 12)
- M11 (South) - 25%
- A14 (East) - 25% (reassigning via M11 Junction 12)
- A1303 / A428 - 15%

11.3.3 On the basis of this worst case assessment of the construction activity trip generation, a worst case assessment of the likely impact on daily flow is shown in Table 11.2 with respect to the 2016 Base Year flows. The flows in this table assume that all access will be from M11 Junction 13 and Madingley Road:

Table 11.2: Construction traffic impacts – Pre Opening

Link No	Link	Base 2016 Daily Flow (24hr, 7 day 1-way flows)		Estimated Daily Construction Traffic (1 way)		Increase		
		All Vehs	Heavy Vehs	Light Vehs	Heavy Vehs	All Vehs	All Vehs	Heavy Vehs
1.0	M11 - J12 - J13 - Nbd	43,702	6,787	3	124	127	0.3%	1.8%
1.0	M11 - J12 - J13 - Sbd	43,702	6,787	3	124	127	0.3%	1.8%
1.1	M11 J13 -J14 - Nbd	32,329	5,021	0	88	88	0.3%	1.7%
1.1	M11 J13 -J14 - Sbd	31,812	4,940	0	88	88	0.3%	1.8%
1.3	M11 J13 off-slip - Nbd	10,033	1,558	3	124	127	1.3%	8.0%
1.3	M11 J13 on-slip - Sbd	7,232	1,123	3	124	127	1.8%	11.0%
2.0	A14 West of J30 (Bar Hill) - Ebd	36,872	6,757	8	51	59	0.2%	0.8%
2.0	A14 West of J30 (Bar Hill) - Wbd	38,330	7,024	8	51	59	0.2%	0.7%
2.1	A14 North East of M11 J14 - Ebd	36,763	6,737	8	51	59	0.2%	0.8%
2.1	A14 North East M11 J14 – Wbd	36,645	6,715	8	51	59	0.2%	0.8%

Link No	Link	Base 2016 Daily Flow (24hr, 7 day 1-way flows)		Estimated Daily Construction Traffic (1 way)		Increase		
		All Vehs	Heavy Vehs	Light Vehs	Heavy Vehs	All Vehs	All Vehs	Heavy Vehs
2.2	A14 West of J32 Interchange - Ebd	38,462	7,048	8	37	44	0.1%	0.5%
2.2	A14 West of J32 Interchange - Wbd	38,462	7,048	8	37	44	0.1%	0.5%
3.0	A1303 East of Madingley Mulch Rbt Ebd	6,608	362	3	22	25	0.4%	6.1%
3.0	A1303 East of Madingley Mulch Rbt Wbd	11,423	625	3	22	25	0.2%	3.5%
3.1	Madingley Rd - East of Cambridge Rd Crossroads Wbd	11,369	622	3	22	25	0.2%	3.5%
3.1	Madingley Rd - East of Cambridge Rd Crossroads Ebd	8,142	446	3	22	25	0.3%	4.9%
3.2	Madingley Rd on Over Bridge M11 Ebd	10,853	594	6	146	152	1.4%	24.6%
3.2	Madingley Rd on Over Bridge M11 Wbd	6,146	337	3	22	25	0.4%	6.5%
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Ebd	9,976	339	6	146	152	1.5%	43.1%
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Wbd	9,335	317	6	146	152	1.6%	46.0%
3.4	Madingley Rd - West of P&R Access Wbd	9,335	317	6	146	152	1.6%	46.0%
3.4	Madingley Rd - West of P&R Access Ebd	9,976	339	6	146	152	1.5%	43.1%
3.5	Madingley Rd - East of P&R Access Wbd	8,451	287	6	146	152	1.8%	50.8%
3.5	Madingley Rd - East of P&R Access Ebd	9,384	319	6	146	152	1.6%	45.8%
3.6	Madingley Rd - East of Proposed High Cross Access Ebd	8,256	281	6	146	152	1.8%	52.0%
3.6	Madingley Rd - East of Proposed High Cross Access Wbd	7,317	249	6	146	152	2.1%	58.7%
3.7	Madingley Rd - East of JJ Thomson Ave Ebd	8,988	305	24	0	24	0.3%	0.0%
3.7	Madingley Rd - East of JJ Thomson Ave Wbd	8,098	275	24	0	24	0.3%	0.0%
3.8	Madingley Rd - East of Clerk Maxwell Rd Ebd	8,774	298	24	0	24	0.3%	0.0%
3.8	Madingley Rd - East of Clerk Maxwell Rd Wbd	8,031	273	24	0	24	0.3%	0.0%

(Links with minimal impact have not been reported)

11.3.4 In terms of impact due to the construction of the Development, the largest increase in existing flows would be the increase of heavy vehicles on Madingley Road between the M11 and the Site Access, where there would be a circa 50% increase in existing heavy vehicles. Nevertheless, this would remain well within the overall capacity of the road – and subsumed within the negligible 2% all vehicle increase.

11.3.5 On all other routes, the increase in general traffic resulting from the construction activity is considered to be negligible.

Appendix 10.2 Existing fear, severance, and intimidation

Appendix 10.2 Existing severance, fear and intimidation

Table A10.2.1 Existing severance, fear and intimidation

Link Ref	Link Description	Severance based on 24 hour Flows	Fear and Intimidation			
			a) Average hourly Flows Over 18 hour day	b) Total 18hr HV Flows	c) Traffic Speed (mph)	d) Weighted Assessmentof a) – c)
1.0	M11 - J12 - J13 - Nbd	41,825	2,328	6,578	70	High
1.0	M11 - J12 - J13 - Sbd	37,287	2,075	5,864	70	High
1.1	M11 J13 -J14 - Nbd	31,262	1,740	4,917	70	High
1.1	M11 J13 -J14 - Sbd	30,763	1,712	4,838	70	High
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Nbd	21,921	1,220	3,448	70	High
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Sbd	22,365	1,245	3,517	70	High
1.3	M11 J13 off-slip - Nbd	10,547	587	1,659	70	Medium
1.3	M11 J13 on-slip - Sbd	6,871	382	1,081	70	Medium
2.0	A14 West of J30 (Bar Hill) - Ebd	35,645	2,152	7,258	70	High
2.0	A14 West of J30 (Bar Hill) - Wbd	37,053	2,237	7,545	70	High
2.1	A14 North West of M11 J14 - Ebd	35,897	2,167	7,310	70	High
2.1	A14 North West M11 J14 - Wbd	35,779	2,160	7,286	70	High
2.2	A14 West of J32 Interchange - Ebd	31,842	1,922	6,484	70	High
2.2	A14 West of J32 Interchange - Wbd	29,753	1,796	6,058	70	High
2.3	A428 -West of M11 J14 - Ebd	11,691	706	2,381	70	High
2.3	A428 - West of M11 J14 - Wbd	10,011	604	2,038	70	High
3.0	A1303 East of Madingley Mulch Rbt Ebd	6,327	364	376	50	Medium
3.0	A1303 East of Madingley Mulch Rbt Wbd	11,248	648	668	50	Medium
3.1	Madingley Rd - East of Cambridge Rd Crossroads Wbd	11,034	635	655	40	Medium
3.1	Madingley Rd - East of Cambridge Rd Crossroads Ebd	6,207	357	369	40	Medium
3.2	Madingley Rd on Over Bridge M11 Ebd	13,177	759	783	40	Medium
3.2	Madingley Rd on Over Bridge M11 Wbd	5,725	330	340	40	Medium
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Ebd	9,622	556	367	40	Medium
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Wbd	9,415	544	360	40	Medium
3.4	Madingley Rd - West of P&R Access Wbd	9,415	544	360	40	Medium
3.4	Madingley Rd - West of P&R Access Ebd	9,622	556	367	40	Medium
3.5	Madingley Rd - East of P&R Access Wbd	9,333	540	356	40	Medium
3.5	Madingley Rd - East of P&R Access Ebd	9,127	528	349	40	Medium
3.6	Madingley Rd - East of Proposed High Cross Access Ebd	7,905	457	302	40	Medium
3.6	Madingley Rd - East of Proposed High Cross Access Wbd	8,196	474	313	40	Medium

Link Ref	Link Description	Severance based on 24 hour Flows	Fear and Intimidation			
			a) Average hourly Flows Over 18 hour day	b) Total 18hr HV Flows	c) Traffic Speed (mph)	d) Weighted Assessmentof a) – c)
3.7	Madingley Rd - East of JJ Thomson Ave Ebd	8,998	520	344	30	Medium
3.7	Madingley Rd - East of JJ Thomson Ave Wbd	9,061	524	346	30	Medium
3.8	Madingley Rd - East of Clerk Maxwell Rd Ebd	8,770	507	335	30	Medium
3.8	Madingley Rd - East of Clerk Maxwell Rd Wbd	9,098	526	347	30	Medium
3.9	Madingley Rd - East of Storey's Way Ebd	7,531	435	288	30	Low
3.9	Madingley Rd - East of Storey's Way Wbd	7,390	427	282	30	Low
3.10	Madingley Rd - East of Grange Road Ebd	7,531	435	288	30	Low
3.10	Madingley Rd - East of Grange Road Wbd	7,390	427	282	30	Low
3.11	Madingley Rd - West of Queen's Rd / Northampton St Rbt Ebd	8,311	481	317	30	Low
3.11	Madingley Rd - West of Queen's Rd / Northampton St Rbt Wbd	7,799	451	298	30	Low
3.12	Northampton St - West of Pound Hill Ebd	6,713	388	256	30	Low
3.12	Northampton St - West of Pound Hill Wbd	6,817	394	260	30	Low
4.0	Huntingdon Rd - West of Proposed NWC HRW Access NWbd	6,104	353	233	60	Low
4.0	Huntingdon Rd - West of Proposed NWC HRW Access SEbd	4,402	255	168	60	Low
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College NWbd	6,104	353	233	30	Low
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College SEbd	4,402	255	168	30	Low
4.2	Huntingdon Rd - East of NWC HRE Access NWbd	8,018	464	306	30	Low
4.2	Huntingdon Rd - East of NWC HRE Access SEbd	6,744	390	258	30	Low
4.3	Huntingdon Rd - East of NIAB Access NWbd	8,652	500	330	30	Low
4.3	Huntingdon Rd - East of NIAB Access SEbd	8,793	508	336	30	Low
4.4	Huntingdon Rd - East of Storey's Way NWbd	8,134	470	311	30	Low
4.4	Huntingdon Rd - East of Storey's Way SEbd	8,067	467	308	30	Low
5.0	Barton Rd - West of Grantchester Rd Ebd	9,616	556	367	30	Low
5.0	Barton Rd - West of Grantchester Rd Wbd	7,599	439	290	30	Low
5.1	Barton Rd - East of Grantchester Rd Ebd	6,354	367	243	30	Low
5.1	Barton Rd - East of Grantchester Rd Wbd	7,268	420	278	30	Low
6.0	Queen's Rd - North of West Rd Nbd	6,726	389	257	30	Low
6.0	Queen's Rd - North of West Rd Sbd	8,012	463	306	30	Low
7.0	Histon Road - South of A14 Nbd	15,439	893	590	40	Medium
7.0	Histon Road - South of A14 Sbd	18,317	1,059	700	40	Medium
8.0	Grange Rd - South of Madingley Rd Nbd	1,933	113	99	30	Negligible
8.0	Grange Rd - South of Madingley Rd Sbd	2,304	135	118	30	Negligible
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Ebd	1,671	98	86	20	Negligible

Link Ref	Link Description	Severance based on 24 hour Flows	Fear and Intimidation			
			a) Average hourly Flows Over 18 hour day	b) Total 18hr HV Flows	c) Traffic Speed (mph)	d) Weighted Assessmentof a) – c)
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Wbd	1,503	88	77	20	Negligible
10.0	Girton Rd - North of Huntingdon Rd Nbd	2,299	135	118	30	Negligible
10.0	Girton Rd - North of Huntingdon Rd Sbd	2,655	155	136	30	Negligible
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Nbd	Minimal	0	0	20	n/a
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Sbd	Minimal	0	0	20	n/a
11.1	Proposed Madingley Rd West Access to NWC Nbd	Not Open	Not Open	Not Open	20	n/a
11.1	Proposed Madingley Rd West Access to NWC Sbd	Not Open	Not Open	Not Open	20	n/a
11.2	Proposed Huntingdon Rd West Access to NWC Nbd	Not Open	Not Open	Not Open	20	n/a
11.2	Proposed Huntingdon Rd West Access to NWC Sbd	Not Open	Not Open	Not Open	20	n/a
11.3	Proposed Huntingdon Rd East Access to NWC Sbd	Not Open	Not Open	Not Open	20	n/a
11.3	Proposed Huntingdon Rd East Access to NWC Nbd	Not Open	Not Open	Not Open	20	n/a
12.0	Western Access to Madingley Rd Nbd	Not Open	Not Open	Not Open	20	n/a
12.0	Western Access to Madingley Rd Sbd	Not Open	Not Open	Not Open	20	n/a
12.1	High Cross Access to Madingley Rd Nbd	1,072	77	92	25	Negligible
12.1	High Cross Access to Madingley Rd Sbd	1,123	81	97	25	Negligible
12.2	JJ Thomson Ave Access to Madingley Rd Nbd	1,274	92	110	25	Negligible
12.2	JJ Thomson Ave Access to Madingley Rd Sbd	1,119	81	96	25	Negligible
12.3	Clerk Maxwell Rd Nbd	349	25	30	30	Negligible
12.3	Clerk Maxwell Rd Sbd	305	22	26	30	Negligible

Level	**Impact**
High	> 90% change
Medium	60% - 90% change
Low	30% - 60% change
< 30% change	Negligible

Appendix 10.3 Traffic flows

31500 West Cambridge

Flows for Environmental Statement - Transport Air Quality and Noise Assessments

2016 Base Flows

		2016 Base Flows					
		2016 Base Flows				>3.5 tonne % and Associated Number of Vehicles	
No.	Link / Notes Refer to Reference Link Plan	Total one-way Vehicles AM Peak	Total one-way Vehicles PM Peak	Observed / estimated Combined one-way 18hr Base 5d flows	Observed / estimated Combined one-way 24hr Base 7d flows	Observed / estimated 18 hr 5d >3.5t flow	Observed / estimated 24 hr 7d >3.5t flow
1.0	M11 - J12 - J13 - Nbd	3,392	3,503	43,775	43,702	6,873	6,787
1.0	M11 - J12 - J13 - Sbd	3,503	3,392	43,775	43,702	6,873	6,787
1.1	M11 J13 -J14 - Nbd	2,199	2,902	32,384	32,329	5,085	5,021
1.1	M11 J13 -J14 - Sbd	2,651	2,368	31,865	31,812	5,003	4,940
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Nbd	1,464	2,144	22,904	22,865	3,596	3,551
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Sbd	2,144	1,534	23,346	23,307	3,666	3,620
1.3	M11 J13 off-slip - Nbd	950	633	10,050	10,033	1,578	1,558
1.3	M11 J13 on-slip - Sbd	353	788	7,244	7,232	1,137	1,123
2.0	A14 West of J30 (Bar Hill) - Ebd	3,685	3,342	40,071	36,872	7,508	6,757
2.0	A14 West of J30 (Bar Hill) - Wbd	3,081	4,224	41,655	38,330	7,805	7,024
2.1	A14 North West of M11 J14 - Ebd	3,697	3,309	39,953	36,763	7,486	6,737
2.1	A14 North West M11 J14 - Wbd	2,994	3,989	39,824	36,645	7,462	6,715
2.2	A14 West of J32 Interchange - Ebd	3,711	3,619	41,798	38,462	7,832	7,048
2.2	A14 West of J32 Interchange - Wbd	3,619	3,711	41,798	38,462	7,832	7,048
2.3	A428 -West of M11 J14 - Ebd	1,567	721	13,046	12,004	2,444	2,200
2.3	A428 - West of M11 J14 - Wbd	756	1,203	11,173	10,281	2,093	1,884
3.0	A1303 East of Madingley Mulch R'bout Ebd	474	513	6,849	6,608	392	362
3.0	A1303 East of Madingley Mulch R'bout Wbd	516	1,190	11,839	11,423	678	625
3.1	Madingley Rd - East of Cambridge Rd Crossroads Wbd	499	1,199	11,783	11,369	675	622
3.1	Madingley Rd - East of Cambridge Rd Crossroads Ebd	722	494	8,439	8,142	484	446
3.2	Madingley Rd on Over Bridge M11 Ebd	1,205	416	11,249	10,853	645	594
3.2	Madingley Rd on Over Bridge M11 Wbd	180	738	6,371	6,146	365	337
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Ebd	1,212	424	10,384	9,976	381	339
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Wbd	321	1,210	9,717	9,335	357	317
3.4	Madingley Rd - West of P&R Access Wbd	321	1,210	9,717	9,335	357	317
3.4	Madingley Rd - West of P&R Access Ebd	1,212	424	10,384	9,976	381	339
3.5	Madingley Rd - East of P&R Access Wbd	368	1,018	8,797	8,451	323	287
3.5	Madingley Rd - East of P&R Access Ebd	1,071	468	9,768	9,384	358	319
3.6	Madingley Rd - East of Proposed High Cross Access Ebd	885	469	8,594	8,256	315	281
3.6	Madingley Rd - East of Proposed High Cross Access Wbd	414	786	7,616	7,317	279	249
3.7	Madingley Rd - East of JJ Thomson Ave Ebd	837	637	9,355	8,988	343	305
3.7	Madingley Rd - East of JJ Thomson Ave Wbd	591	737	8,429	8,098	309	275
3.8	Madingley Rd - East of Clerk Maxwell Rd Ebd	755	684	9,133	8,774	335	298
3.8	Madingley Rd - East of Clerk Maxwell Rd Wbd	643	674	8,359	8,031	307	273
3.9	Madingley Rd - East of Storey's Way Ebd	685	566	7,939	7,627	291	259
3.9	Madingley Rd - East of Storey's Way Wbd	628	599	7,792	7,485	286	254
3.10	Madingley Rd - East of Grange Road Ebd	685	566	7,939	7,627	291	259
3.10	Madingley Rd - East of Grange Road Wbd	628	599	7,792	7,485	286	254
3.11	Madingley Rd - West of Queen's Rd / Northampton St R'bout Ebd	807	573	8,761	8,417	321	286
3.11	Madingley Rd - West of Queen's Rd / Northampton St R'bout Wbd	588	708	8,223	7,900	302	269
3.12	Northampton St - West of Pound Hill Ebd	463	652	7,079	6,801	260	231
3.12	Northampton St - West of Pound Hill Wbd	558	575	7,188	6,905	264	235
4.0	Huntingdon Rd - West of Proposed NWC HRW Access NWbd	326	689	6,438	6,185	236	210
4.0	Huntingdon Rd - West of Proposed NWC HRW Access SEbd	400	332	4,641	4,459	170	152
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College NWbd	326	689	6,438	6,185	236	210
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College SEbd	400	332	4,641	4,459	170	152
4.2	Huntingdon Rd - East of NWC HRW Access NWbd	389	944	8,458	8,125	310	276
4.2	Huntingdon Rd - East of NWC HRW Access SEbd	668	452	7,109	6,829	261	232
4.3	Huntingdon Rd - East of NIAB Access NWbd	443	995	9,126	8,768	335	298
4.3	Huntingdon Rd - East of NIAB Access SEbd	942	518	9,268	8,903	340	303
4.4	Huntingdon Rd - East of Storey's Way NWbd	462	889	8,579	8,242	315	280
4.4	Huntingdon Rd - East of Storey's Way SEbd	792	548	8,504	8,170	312	278
5.0	Barton Rd - West of Grantchester Rd Ebd	1,115	489	10,178	9,778	373	332
5.0	Barton Rd - West of Grantchester Rd Wbd	303	968	8,066	7,749	296	263

5.1	Barton Rd - East of Grantchester Rd Ebd	618	437	6,698	6,434	246	219
5.1	Barton Rd - East of Grantchester Rd Wbd	282	926	7,668	7,366	281	250
6.0	Queen's Rd - North of West Rd Nbd	463	654	7,092	6,814	260	232
6.0	Queen's Rd - North of West Rd Sbd	781	550	8,446	8,114	310	276
7.0	Histon Road - South of A14 Nbd	946	1,619	16,283	15,643	597	532
7.0	Histon Road - South of A14 Sbd	1,825	1,217	19,308	18,549	708	630
7.1	Histon Rd - South of Akeman St Nbd			0	0	0	0
7.1	Histon Rd - South of Akeman St Sbd			0	0	0	0
8.0	Grange Rd - South of Madingley Rd Nbd	195	201	2,063	1,958	100	87
8.0	Grange Rd - South of Madingley Rd Sbd	321	151	2,458	2,333	119	103
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Ebd	260	82	1,782	1,692	87	75
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Wbd	91	217	1,605	1,523	78	67
10.0	Girton Rd - North of Huntingdon Rd Nbd	137	335	2,454	2,330	119	103
10.0	Girton Rd - North of Huntingdon Rd Sbd	342	202	2,832	2,689	138	119
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Nbd	0	0	0	0	0	0
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Sbd	0	0	0	0	0	0
11.1	Proposed Madingley Rd West Access to NWC Nbd	0	0	0	0	0	0
11.1	Proposed Madingley Rd West Access to NWC Sbd	0	0	0	0	0	0
11.2	Proposed Huntingdon Rd West Access to NWC Nbd	0	0	0	0	0	0
11.2	Proposed Huntingdon Rd West Access to NWC Sbd	0	0	0	0	0	0
11.3	Proposed Huntingdon Rd East Access to NWC Sbd	0	0	0	0	0	0
11.3	Proposed Huntingdon Rd East Access to NWC Nbd	0	0	0	0	0	0
12.0	Western Access to Madingley Rd Nbd	0	0	0	0	0	0
12.0	Western Access to Madingley Rd Sbd	0	0	0	0	0	0
12.1	High Cross Access to Madingley Rd Nbd	36	257	1,377	1,061	91	66
12.1	High Cross Access to Madingley Rd Sbd	275	46	1,508	1,162	100	73
12.2	JJ Thomson Ave Access to Madingley Rd Nbd	90	227	1,490	1,148	99	72
12.2	JJ Thomson Ave Access to Madingley Rd Sbd	238	77	1,480	1,141	98	71
12.3	Clerk Maxwell Rd Nbd - south of Car Park Access	10	32	197	152	13	10
12.3	Clerk Maxwell Rd Sbd - south of Car Park Access	38	9	221	170	15	11
12.4	Clerk Maxwell Rd Sbd - north of Car Park Access	119	9	601	464	40	29
12.4	Clerk Maxwell Rd Nbd - north of Car Park Access	4	103	503	387	33	24

31500 West Cambridge

Flows for Environmental Statement - Transport Air Quality and Noise Assessments

2021ES DM Flows

		2021ES DM Flows					
		2021ES DM Flows				>3.5 tonne % and Associated Number of Vehicles	
No.	Link / Notes Refer to Reference Link Plan	Total one-way Vehicles AM Peak	Total one-way Vehicles PM Peak	Observed / estimated Combined one-way 18hr Base 5d flows	Observed / estimated Combined one-way 24hr Base 7d flows	Observed / estimated 18 hr 5d >3.5t flow	Observed / estimated 24 hr 7d >3.5t flow
1.0	M11 - J12 - J13 - Nbd	3,583	3,743	46,509	46,431	7,302	7,211
1.0	M11 - J12 - J13 - Sbd	3,703	3,688	46,924	46,846	7,368	7,275
1.1	M11 J13 -J14 - Nbd	2,341	2,985	33,816	33,759	5,309	5,243
1.1	M11 J13 -J14 - Sbd	2,736	2,520	33,370	33,314	5,239	5,174
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Nbd	1,575	2,213	24,053	24,013	3,777	3,729
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Sbd	2,213	1,645	24,488	24,447	3,845	3,797
1.3	M11 J13 off-slip - Nbd	999	790	11,359	11,340	1,783	1,761
1.3	M11 J13 on-slip - Sbd	467	933	8,883	8,868	1,395	1,377
2.0	A14 West of J30 (Bar Hill) - Ebd	3,686	3,433	40,597	37,356	7,607	6,846
2.0	A14 West of J30 (Bar Hill) - Wbd	3,150	4,277	42,351	38,970	7,935	7,142
2.1	A14 North West of M11 J14 - Ebd	3,684	3,459	40,734	37,483	7,632	6,869
2.1	A14 North West M11 J14 - Wbd	3,148	3,984	40,670	37,424	7,620	6,858
2.2	A14 West of J32 Interchange - Ebd	3,818	3,795	43,416	39,951	8,135	7,321
2.2	A14 West of J32 Interchange - Wbd	3,799	3,817	43,432	39,965	8,138	7,324
2.3	A428 -West of M11 J14 - Ebd	1,604	756	13,458	12,383	2,522	2,269
2.3	A428 - West of M11 J14 - Wbd	791	1,234	11,547	10,625	2,163	1,947
3.0	A1303 East of Madingley Mulch R'bout Ebd	529	580	7,695	7,425	441	406
3.0	A1303 East of Madingley Mulch R'bout Wbd	569	1,262	12,705	12,258	728	671
3.1	Madingley Rd - East of Cambridge Rd Crossroads Wbd	537	1,162	11,789	11,374	675	623
3.1	Madingley Rd - East of Cambridge Rd Crossroads Ebd	692	561	8,694	8,388	498	459
3.2	Madingley Rd on Over Bridge M11 Ebd	1,203	613	12,599	12,156	722	666
3.2	Madingley Rd on Over Bridge M11 Wbd	197	672	6,033	5,820	346	319
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Ebd	1,180	595	11,266	10,823	413	368
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Wbd	423	1,264	10,707	10,286	393	350
3.4	Madingley Rd - West of P&R Access Wbd	423	1,264	10,707	10,286	393	350
3.4	Madingley Rd - West of P&R Access Ebd	1,180	595	11,266	10,823	413	368
3.5	Madingley Rd - East of P&R Access Wbd	470	1,072	9,787	9,402	359	320
3.5	Madingley Rd - East of P&R Access Ebd	1,039	639	10,650	10,232	391	348
3.6	Madingley Rd - East of Proposed High Cross Access Ebd	991	485	9,363	8,995	344	306
3.6	Madingley Rd - East of Proposed High Cross Access Wbd	403	944	8,548	8,212	314	279
3.7	Madingley Rd - East of JJ Thomson Ave Ebd	929	702	10,352	9,945	380	338
3.7	Madingley Rd - East of JJ Thomson Ave Wbd	552	874	9,052	8,696	332	296
3.8	Madingley Rd - East of Clerk Maxwell Rd Ebd	848	752	10,158	9,759	373	332
3.8	Madingley Rd - East of Clerk Maxwell Rd Wbd	607	813	9,011	8,657	331	294
3.9	Madingley Rd - East of Storey's Way Ebd	772	641	8,970	8,617	329	293
3.9	Madingley Rd - East of Storey's Way Wbd	632	743	8,725	8,382	320	285
3.10	Madingley Rd - East of Grange Road Ebd	765	641	8,925	8,575	327	291
3.10	Madingley Rd - East of Grange Road Wbd	634	736	8,695	8,353	319	284
3.11	Madingley Rd - West of Queen's Rd / Northampton St R'bout Ebd	899	678	10,007	9,614	367	327
3.11	Madingley Rd - West of Queen's Rd / Northampton St R'bout Wbd	660	848	9,568	9,192	351	312
3.12	Northampton St - West of Pound Hill Ebd	503	761	8,024	7,708	294	262
3.12	Northampton St - West of Pound Hill Wbd	668	647	8,344	8,017	306	272
4.0	Huntingdon Rd - West of Proposed NWC HRW Access NWbd	457	853	8,315	7,988	305	271
4.0	Huntingdon Rd - West of Proposed NWC HRW Access SEbd	489	476	6,126	5,886	225	200
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College NWbd	411	719	7,172	6,890	263	234
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College SEbd	395	401	5,054	4,855	185	165
4.2	Huntingdon Rd - East of NWC HRW Access NWbd	568	1,173	11,053	10,619	406	361
4.2	Huntingdon Rd - East of NWC HRW Access SEbd	900	687	10,070	9,675	369	329
4.3	Huntingdon Rd - East of NIAB Access NWbd	588	1,252	11,680	11,221	429	381
4.3	Huntingdon Rd - East of NIAB Access SEbd	1,221	721	12,326	11,841	452	402
4.4	Huntingdon Rd - East of Storey's Way NWbd	591	1,142	10,999	10,567	404	359
4.4	Huntingdon Rd - East of Storey's Way SEbd	1,096	745	11,682	11,223	429	381
5.0	Barton Rd - West of Grantchester Rd Ebd	1,128	506	10,373	9,965	381	339
5.0	Barton Rd - West of Grantchester Rd Wbd	314	977	8,193	7,871	301	268

5.1	Barton Rd - East of Grantchester Rd Ebd	632	454	6,893	6,622	253	225
5.1	Barton Rd - East of Grantchester Rd Wbd	293	935	7,794	7,488	286	254
6.0	Queen's Rd - North of West Rd Nbd	489	701	7,553	7,256	277	247
6.0	Queen's Rd - North of West Rd Sbd	828	572	8,881	8,532	326	290
7.0	Histon Road - South of A14 Nbd	1,086	1,687	17,600	16,908	646	575
7.0	Histon Road - South of A14 Sbd	1,807	1,379	20,217	19,423	742	660
8.0	Grange Rd - South of Madingley Rd Nbd	197	212	2,130	2,022	103	89
8.0	Grange Rd - South of Madingley Rd Sbd	331	156	2,537	2,408	123	107
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Ebd	209	70	1,453	1,380	71	61
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Wbd	86	201	1,496	1,420	73	63
10.0	Girton Rd - North of Huntingdon Rd Nbd	152	363	2,678	2,542	130	113
10.0	Girton Rd - North of Huntingdon Rd Sbd	364	224	3,058	2,903	149	128
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Nbd	8	86	445	343	30	21
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Sbd	91	27	552	425	37	27
11.1	Proposed Madingley Rd West Access to NWC Nbd	96	405	2,354	1,814	156	114
11.1	Proposed Madingley Rd West Access to NWC Sbd	299	208	2,382	1,836	158	115
11.2	Proposed Huntingdon Rd West Access to NWC Nbd	46	133	841	648	56	41
11.2	Proposed Huntingdon Rd West Access to NWC Sbd	94	75	794	612	53	38
11.3	Proposed Huntingdon Rd East Access to NWC Sbd	151	250	1,884	1,452	125	91
11.3	Proposed Huntingdon Rd East Access to NWC Nbd	286	222	2,387	1,840	158	115
12.0	Western Access to Madingley Rd Nbd	0	0	0	0	0	0
12.0	Western Access to Madingley Rd Sbd	0	0	0	0	0	0
12.1	High Cross Access to Madingley Rd Nbd	18	201	1,031	794	68	50
12.1	High Cross Access to Madingley Rd Sbd	212	52	1,240	956	82	60
12.2	JJ Thomson Ave Access to Madingley Rd Nbd	79	291	1,740	1,341	115	84
12.2	JJ Thomson Ave Access to Madingley Rd Sbd	213	70	1,329	1,024	88	64
12.3	Clerk Maxwell Rd Nbd - south of Car Park Access			199	154	13	10
12.3	Clerk Maxwell Rd Sbd - south of Car Park Access			194	158	13	10
12.4	Clerk Maxwell Rd Sbd - north of Car Park Access			498	397	33	25
12.4	Clerk Maxwell Rd Nbd - north of Car Park Access			508	405	34	25
				Found in 170531 Asst of 24hr Movts on CMR			

31500 West Cambridge

Flows for Environmental Statement - Transport Air Quality and Noise Assessments

2021 DS Flows

		2021 DS Flows					
		2021 DS Flows				>3.5 tonne % and Associated Number of Vehicles	
No.	Link / Notes Refer to Reference Link Plan	Total one-way Vehicles AM Peak	Total one-way Vehicles PM Peak	Observed / estimated Combined one-way 18hr Base 5d flows	Observed / estimated Combined one-way 24hr Base 7d flows	Observed / estimated 18 hr 5d >3.5t flow	Observed / estimated 24 hr 7d >3.5t flow
1.0	M11 - J12 - J13 - Nbd	3,665	3,729	46,943	46,864	7,370	7,278
1.0	M11 - J12 - J13 - Sbd	3,679	3,736	47,072	46,993	7,391	7,298
1.1	M11 J13 -J14 - Nbd	2,317	2,974	33,589	33,533	5,274	5,208
1.1	M11 J13 -J14 - Sbd	2,719	2,503	33,154	33,099	5,206	5,140
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Nbd	1,556	2,203	23,865	23,825	3,747	3,700
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Sbd	2,198	1,630	24,306	24,266	3,816	3,768
1.3	M11 J13 off-slip - Nbd	1,105	787	12,012	11,992	1,886	1,862
1.3	M11 J13 on-slip - Sbd	461	996	9,252	9,236	1,453	1,434
2.0	A14 West of J30 (Bar Hill) - Ebd	3,828	3,439	41,441	38,133	7,765	6,988
2.0	A14 West of J30 (Bar Hill) - Wbd	3,157	4,379	42,972	39,541	8,052	7,246
2.1	A14 North West of M11 J14 - Ebd	3,973	3,649	43,466	39,996	8,144	7,330
2.1	A14 North West M11 J14 - Wbd	3,312	4,263	43,196	39,748	8,094	7,284
2.2	A14 West of J32 Interchange - Ebd	3,808	3,767	43,194	39,746	8,093	7,284
2.2	A14 West of J32 Interchange - Wbd	3,762	3,815	43,204	39,755	8,095	7,285
2.3	A428 -West of M11 J14 - Ebd	1,599	752	13,408	12,338	2,512	2,261
2.3	A428 - West of M11 J14 - Wbd	785	1,233	11,502	10,584	2,155	1,940
3.0	A1303 East of Madingley Mulch R'bout Ebd	562	580	7,930	7,651	454	419
3.0	A1303 East of Madingley Mulch R'bout Wbd	566	1,286	12,851	12,399	736	679
3.1	Madingley Rd - East of Cambridge Rd Crossroads Wbd	535	1,187	11,945	11,525	684	631
3.1	Madingley Rd - East of Cambridge Rd Crossroads Ebd	730	561	8,958	8,643	513	473
3.2	Madingley Rd on Over Bridge M11 Ebd	1,349	612	13,614	13,136	780	719
3.2	Madingley Rd on Over Bridge M11 Wbd	197	701	6,234	6,014	357	329
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Ebd	1,334	595	12,242	11,761	449	400
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Wbd	424	1,356	11,294	10,850	414	369
3.4	Madingley Rd - West of P&R Access Wbd	478	1,384	11,818	11,354	434	386
3.4	Madingley Rd - West of P&R Access Ebd	1,374	608	12,580	12,085	462	411
3.5	Madingley Rd - East of P&R Access Wbd	498	1,198	10,765	10,341	395	351
3.5	Madingley Rd - East of P&R Access Ebd	1,241	664	12,091	11,616	444	395
3.6	Madingley Rd - East of Proposed High Cross Access Ebd	1,176	685	11,812	11,348	433	386
3.6	Madingley Rd - East of Proposed High Cross Access Wbd	578	1,053	10,352	9,945	380	338
3.7	Madingley Rd - East of JJ Thomson Ave Ebd	996	797	11,380	10,933	418	372
3.7	Madingley Rd - East of JJ Thomson Ave Wbd	688	898	10,066	9,671	369	329
3.8	Madingley Rd - East of Clerk Maxwell Rd Ebd	882	934	11,521	11,068	423	376
3.8	Madingley Rd - East of Clerk Maxwell Rd Wbd	868	833	10,794	10,370	396	352
3.9	Madingley Rd - East of Storey's Way Ebd	815	830	10,443	10,032	383	341
3.9	Madingley Rd - East of Storey's Way Wbd	904	769	10,615	10,198	389	347
3.10	Madingley Rd - East of Grange Road Ebd	806	824	10,342	9,936	379	338
3.10	Madingley Rd - East of Grange Road Wbd	899	758	10,517	10,104	386	343
3.11	Madingley Rd - West of Queen's Rd / Northampton St R'bout Ebd	909	698	10,197	9,796	374	333
3.11	Madingley Rd - West of Queen's Rd / Northampton St R'bout Wbd	697	849	9,812	9,427	360	320
3.12	Northampton St - West of Pound Hill Ebd	513	768	8,134	7,814	298	266
3.12	Northampton St - West of Pound Hill Wbd	659	650	8,305	7,978	305	271
4.0	Huntingdon Rd - West of Proposed NWC HRW Access NWbd	461	985	9,181	8,820	337	300
4.0	Huntingdon Rd - West of Proposed NWC HRW Access SEbd	671	481	7,307	7,020	268	239
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College NWbd	393	721	7,074	6,796	260	231
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College SEbd	394	396	5,014	4,817	184	164
4.2	Huntingdon Rd - East of NWC HRW Access NWbd	557	1,174	10,991	10,559	403	359
4.2	Huntingdon Rd - East of NWC HRW Access SEbd	807	695	9,531	9,157	350	311
4.3	Huntingdon Rd - East of NIAB Access NWbd	571	1,247	11,540	11,086	423	377
4.3	Huntingdon Rd - East of NIAB Access SEbd	1,120	722	11,688	11,229	429	382
4.4	Huntingdon Rd - East of Storey's Way NWbd	565	1,131	10,765	10,342	395	351
4.4	Huntingdon Rd - East of Storey's Way SEbd	999	732	10,981	10,549	403	359
5.0	Barton Rd - West of Grantchester Rd Ebd	1,128	505	10,361	9,953	380	338
5.0	Barton Rd - West of Grantchester Rd Wbd	312	977	8,185	7,863	300	267

5.1	Barton Rd - East of Grantchester Rd Ebd	631	453	6,880	6,610	252	225
5.1	Barton Rd - East of Grantchester Rd Wbd	292	935	7,786	7,480	286	254
6.0	Queen's Rd - North of West Rd Nbd	522	771	8,207	7,884	301	268
6.0	Queen's Rd - North of West Rd Sbd	883	609	9,470	9,098	347	309
7.0	Histon Road - South of A14 Nbd	1,085	1,837	18,541	17,813	680	605
7.0	Histon Road - South of A14 Sbd	2,019	1,381	21,577	20,729	792	705
8.0	Grange Rd - South of Madingley Rd Nbd	203	215	2,178	2,068	106	92
8.0	Grange Rd - South of Madingley Rd Sbd	333	161	2,575	2,445	125	108
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Ebd	209	70	1,452	1,378	71	61
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Wbd	86	201	1,496	1,421	73	63
10.0	Girton Rd - North of Huntingdon Rd Nbd	150	365	2,686	2,550	130	113
10.0	Girton Rd - North of Huntingdon Rd Sbd	368	224	3,082	2,926	150	129
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Nbd	12	93	493	380	33	24
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Sbd	92	32	580	447	39	28
11.1	Proposed Madingley Rd West Access to NWC Nbd	139	576	3,360	2,589	223	162
11.1	Proposed Madingley Rd West Access to NWC Sbd	514	230	3,495	2,693	232	168
11.2	Proposed Huntingdon Rd West Access to NWC Nbd	68	264	1,560	1,202	104	75
11.2	Proposed Huntingdon Rd West Access to NWC Sbd	276	85	1,698	1,308	113	82
11.3	Proposed Huntingdon Rd East Access to NWC Sbd	149	247	1,864	1,436	124	90
11.3	Proposed Huntingdon Rd East Access to NWC Nbd	181	237	1,961	1,511	130	95
12.0	Western Access to Madingley Rd Nbd	0	0	0	0	0	0
12.0	Western Access to Madingley Rd Sbd	0	0	0	0	0	0
12.1	High Cross Access to Madingley Rd Nbd	109	620	3,426	2,640	227	165
12.1	High Cross Access to Madingley Rd Sbd	656	113	3,614	2,785	240	174
12.2	JJ Thomson Ave Access to Madingley Rd Nbd	77	233	1,457	1,123	97	70
12.2	JJ Thomson Ave Access to Madingley Rd Sbd	288	50	1,588	1,224	105	77
12.3	Clerk Maxwell Rd Nbd - south of Car Park Access			65	52	4	3
12.3	Clerk Maxwell Rd Sbd - south of Car Park Access			62	50	4	3
12.4	Clerk Maxwell Rd Sbd - north of Car Park Access			1,002	799	67	50
12.4	Clerk Maxwell Rd Nbd - north of Car Park Access			1,021	814	68	54

Found in 170531 Asst of 24hr Movts on CMR

Flows found in 170601 - Junction Turning Movements

31500 West Cambridge

Flows for Environmental Statement - Transport Air Quality and Noise Assessments

2031 ES DM Flows

		2031 ES DM Flows					
		2031 ES DM Flows				>3.5 tonne % and Associated Number of Vehicles	
No.	Link / Notes Refer to Reference Link Plan	Total one-way Vehicles AM Peak	Total one-way Vehicles PM Peak	Observed / estimated Combined one-way 18hr Base 5d flows	Observed / estimated Combined one-way 24hr Base 7d flows	Observed / estimated 18 hr 5d >3.5t flow	Observed / estimated 24 hr 7d >3.5t flow
1.0	M11 - J12 - J13 - Nbd	3,639	3,948	48,166	48,086	7,563	7,468
1.0	M11 - J12 - J13 - Sbd	3,930	3,797	49,057	48,975	7,702	7,606
1.1	M11 J13 -J14 - Nbd	2,368	3,114	34,806	34,748	5,465	5,396
1.1	M11 J13 -J14 - Sbd	2,880	2,573	34,620	34,562	5,436	5,368
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Nbd	1,603	2,328	24,961	24,919	3,919	3,870
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Sbd	2,333	1,694	25,561	25,519	4,013	3,963
1.3	M11 J13 off-slip - Nbd	1,028	864	12,013	11,993	1,886	1,862
1.3	M11 J13 on-slip - Sbd	550	989	9,765	9,749	1,533	1,514
2.0	A14 West of J30 (Bar Hill) - Ebd	3,762	3,473	41,258	37,965	7,731	6,957
2.0	A14 West of J30 (Bar Hill) - Wbd	3,185	4,358	43,012	39,579	8,059	7,253
2.1	A14 North West of M11 J14 - Ebd	3,785	3,606	42,149	38,784	7,897	7,107
2.1	A14 North West M11 J14 - Wbd	3,287	4,079	42,004	38,651	7,870	7,083
2.2	A14 West of J32 Interchange - Ebd	3,919	3,942	44,831	41,252	8,400	7,560
2.2	A14 West of J32 Interchange - Wbd	3,938	3,912	44,767	41,193	8,388	7,549
2.3	A428 -West of M11 J14 - Ebd	1,643	826	14,079	12,955	2,638	2,374
2.3	A428 - West of M11 J14 - Wbd	863	1,267	12,145	11,176	2,276	2,048
3.0	A1303 East of Madingley Mulch R'bout Ebd	597	637	8,563	8,262	491	452
3.0	A1303 East of Madingley Mulch R'bout Wbd	619	1,330	13,523	13,048	775	714
3.1	Madingley Rd - East of Cambridge Rd Crossroads Wbd	587	1,230	12,607	12,164	722	666
3.1	Madingley Rd - East of Cambridge Rd Crossroads Ebd	760	619	9,568	9,231	548	505
3.2	Madingley Rd on Over Bridge M11 Ebd	1,286	716	13,889	13,401	796	734
3.2	Madingley Rd on Over Bridge M11 Wbd	233	711	6,553	6,323	375	346
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Ebd	1,226	679	12,091	11,616	444	395
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Wbd	505	1,339	11,704	11,244	429	382
3.4	Madingley Rd - West of P&R Access Wbd	505	1,339	11,704	11,244	429	382
3.4	Madingley Rd - West of P&R Access Ebd	1,226	679	12,091	11,616	444	395
3.5	Madingley Rd - East of P&R Access Wbd	552	1,147	10,783	10,359	396	352
3.5	Madingley Rd - East of P&R Access Ebd	1,085	723	11,475	11,024	421	375
3.6	Madingley Rd - East of Proposed High Cross Access Ebd	1,068	514	10,036	9,642	368	328
3.6	Madingley Rd - East of Proposed High Cross Access Wbd	426	1,049	9,360	8,992	343	306
3.7	Madingley Rd - East of JJ Thomson Ave Ebd	977	762	11,038	10,604	405	360
3.7	Madingley Rd - East of JJ Thomson Ave Wbd	594	928	9,661	9,282	354	315
3.8	Madingley Rd - East of Clerk Maxwell Rd Ebd	896	812	10,843	10,417	398	354
3.8	Madingley Rd - East of Clerk Maxwell Rd Wbd	649	867	9,621	9,243	353	314
3.9	Madingley Rd - East of Storey's Way Ebd	819	698	9,630	9,251	353	314
3.9	Madingley Rd - East of Storey's Way Wbd	674	796	9,328	8,962	342	305
3.10	Madingley Rd - East of Grange Road Ebd	809	699	9,573	9,197	351	313
3.10	Madingley Rd - East of Grange Road Wbd	679	785	9,292	8,926	341	303
3.11	Madingley Rd - West of Queen's Rd / Northampton St R'bout Ebd	940	709	10,464	10,053	384	342
3.11	Madingley Rd - West of Queen's Rd / Northampton St R'bout Wbd	685	891	10,000	9,607	367	327
3.12	Northampton St - West of Pound Hill Ebd	512	826	8,493	8,160	312	277
3.12	Northampton St - West of Pound Hill Wbd	730	665	8,852	8,504	325	289
4.0	Huntingdon Rd - West of Proposed NWC HRW Access NWbd	513	923	9,114	8,756	334	298
4.0	Huntingdon Rd - West of Proposed NWC HRW Access SEbd	546	545	6,926	6,654	254	226
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College NWbd	465	769	7,832	7,525	287	256
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College SEbd	440	467	5,758	5,532	211	188
4.2	Huntingdon Rd - East of NWC HRW Access NWbd	620	1,276	12,037	11,564	442	393
4.2	Huntingdon Rd - East of NWC HRW Access SEbd	1,006	766	11,244	10,803	413	367
4.3	Huntingdon Rd - East of NIAB Access NWbd	601	1,388	12,626	12,130	463	412
4.3	Huntingdon Rd - East of NIAB Access SEbd	1,378	768	13,621	13,085	500	445
4.4	Huntingdon Rd - East of Storey's Way NWbd	605	1,273	11,919	11,451	437	389
4.4	Huntingdon Rd - East of Storey's Way SEbd	1,249	790	12,939	12,431	475	422
5.0	Barton Rd - West of Grantchester Rd Ebd	1,139	512	10,481	10,069	385	342
5.0	Barton Rd - West of Grantchester Rd Wbd	318	988	8,288	7,962	304	271

5.1	Barton Rd - East of Grantchester Rd Ebd	643	460	7,001	6,725	257	229
5.1	Barton Rd - East of Grantchester Rd Wbd	297	946	7,889	7,579	289	258
6.0	Queen's Rd - North of West Rd Nbd	506	741	7,915	7,604	290	258
6.0	Queen's Rd - North of West Rd Sbd	871	590	9,269	8,904	340	303
7.0	Histon Road - South of A14 Nbd	1,166	1,753	18,526	17,798	680	605
7.0	Histon Road - South of A14 Sbd	1,859	1,457	21,042	20,215	772	687
8.0	Grange Rd - South of Madingley Rd Nbd	198	220	2,177	2,067	106	91
8.0	Grange Rd - South of Madingley Rd Sbd	339	158	2,589	2,457	126	109
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Ebd	211	70	1,464	1,389	71	61
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Wbd	87	203	1,512	1,435	73	64
10.0	Girton Rd - North of Huntingdon Rd Nbd	155	369	2,725	2,587	132	114
10.0	Girton Rd - North of Huntingdon Rd Sbd	370	227	3,105	2,948	151	130
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Nbd	20	181	947	730	63	46
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Sbd	191	57	1,163	896	77	56
11.1	Proposed Madingley Rd West Access to NWC Nbd	104	515	2,909	2,242	193	140
11.1	Proposed Madingley Rd West Access to NWC Sbd	398	234	2,970	2,289	197	143
11.2	Proposed Huntingdon Rd West Access to NWC Nbd	49	154	954	735	63	46
11.2	Proposed Huntingdon Rd West Access to NWC Sbd	107	79	874	674	58	42
11.3	Proposed Huntingdon Rd East Access to NWC Sbd	177	335	2,406	1,854	160	116
11.3	Proposed Huntingdon Rd East Access to NWC Nbd	374	271	3,031	2,336	201	146
12.0	Western Access to Madingley Rd Nbd	0	0	0	0	0	0
12.0	Western Access to Madingley Rd Sbd	0	0	0	0	0	0
12.1	High Cross Access to Madingley Rd Nbd	18	201	1,031	794	68	50
12.1	High Cross Access to Madingley Rd Sbd	212	52	1,240	956	82	60
12.2	JJ Thomson Ave Access to Madingley Rd Nbd	79	291	1,740	1,341	115	84
12.2	JJ Thomson Ave Access to Madingley Rd Sbd	213	70	1,329	1,024	88	64
12.3	Clerk Maxwell Rd Nbd - south of Car Park Access			199	158	13	10
12.3	Clerk Maxwell Rd Sbd - south of Car Park Access			194	154	13	10
12.4	Clerk Maxwell Rd Sbd - north of Car Park Access			498	397	33	25
12.4	Clerk Maxwell Rd Nbd - north of Car Park Access			508	405	34	25
				Found in 170531 Asst of 24hr Movts on CMR			

31500 West Cambridge

Flows for Environmental Statement - Transport Air Quality and Noise Assessments

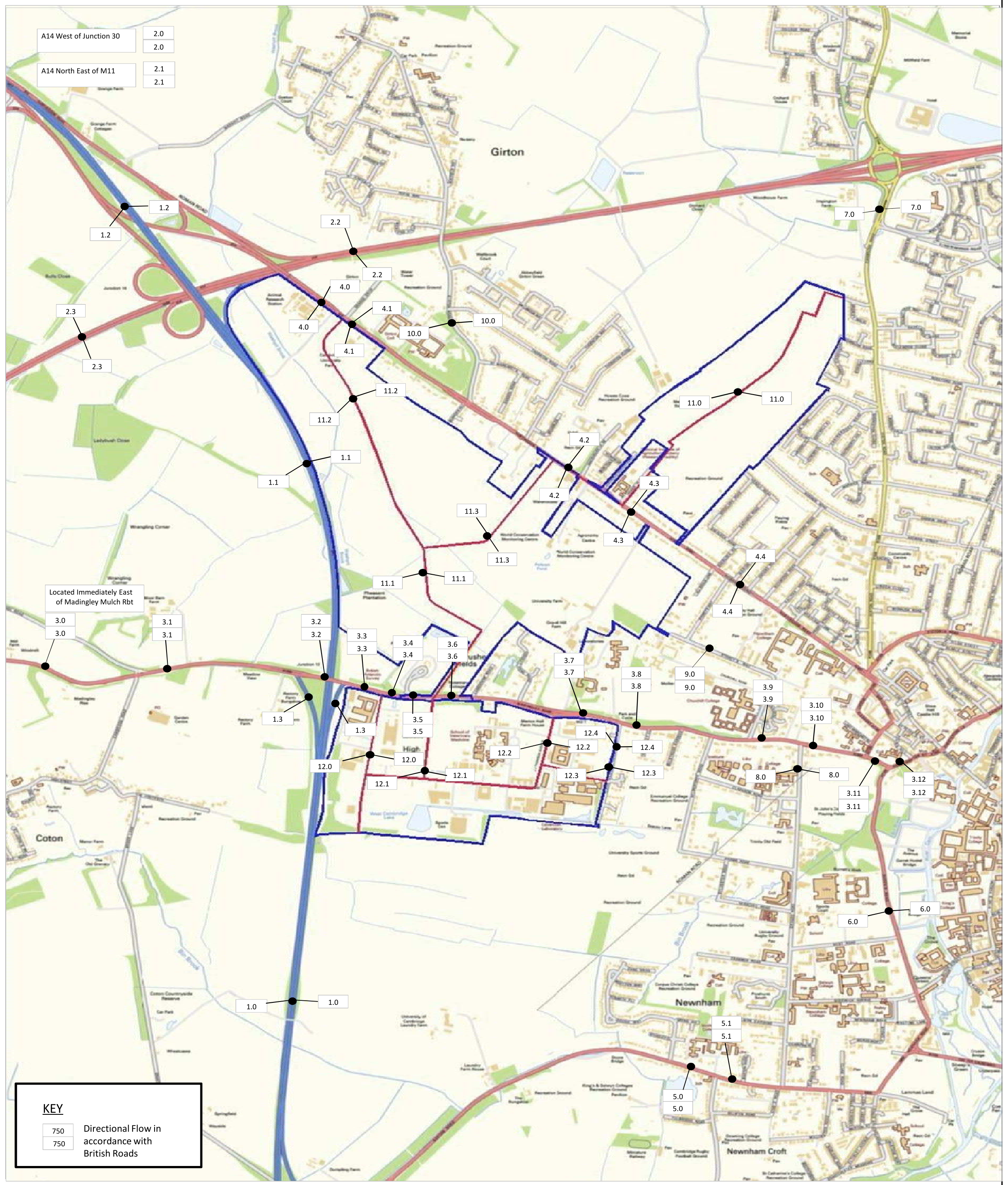
2031 DS Flows

		2031 DS Flows					
		2031 DS Flows				>3.5 tonne % and Associated Number of Vehicles	
No.	Link / Notes Refer to Reference Link Plan	Total one-way Vehicles AM Peak	Total one-way Vehicles PM Peak	Observed / estimated Combined one-way 18hr Base 5d flows	Observed / estimated Combined one-way 24hr Base 7d flows	Observed / estimated 18 hr 5d >3.5t flow	Observed / estimated 24 hr 7d >3.5t flow
1.0	M11 - J12 - J13 - Nbd	3,891	3,926	49,630	49,547	7,792	7,695
1.0	M11 - J12 - J13 - Sbd	3,885	4,001	50,066	49,982	7,861	7,762
1.1	M11 J13 -J14 - Nbd	2,343	3,093	34,511	34,453	5,419	5,351
1.1	M11 J13 -J14 - Sbd	2,841	2,557	34,272	34,214	5,381	5,313
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Nbd	1,583	2,309	24,709	24,668	3,880	3,831
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Sbd	2,302	1,681	25,284	25,242	3,970	3,920
1.3	M11 J13 off-slip - Nbd	1,305	865	13,778	13,755	2,163	2,136
1.3	M11 J13 on-slip - Sbd	545	1,208	11,129	11,110	1,747	1,725
2.0	A14 West of J30 (Bar Hill) - Ebd	4,095	3,491	43,256	39,803	8,105	7,294
2.0	A14 West of J30 (Bar Hill) - Wbd	3,206	4,613	44,583	41,025	8,354	7,518
2.1	A14 North West of M11 J14 - Ebd	4,453	3,847	47,330	43,552	8,868	7,981
2.1	A14 North West M11 J14 - Wbd	3,453	4,717	46,588	42,869	8,729	7,856
2.2	A14 West of J32 Interchange - Ebd	3,907	3,901	44,525	40,971	8,343	7,508
2.2	A14 West of J32 Interchange - Wbd	3,880	3,915	44,448	40,900	8,328	7,495
2.3	A428 -West of M11 J14 - Ebd	1,636	811	13,954	12,840	2,615	2,353
2.3	A428 - West of M11 J14 - Wbd	843	1,266	12,028	11,068	2,254	2,028
3.0	A1303 East of Madingley Mulch R'bout Ebd	695	638	9,253	8,928	530	489
3.0	A1303 East of Madingley Mulch R'bout Wbd	615	1,409	14,046	13,552	805	742
3.1	Madingley Rd - East of Cambridge Rd Crossroads Wbd	584	1,317	13,195	12,731	756	697
3.1	Madingley Rd - East of Cambridge Rd Crossroads Ebd	871	619	10,340	9,976	592	546
3.2	Madingley Rd on Over Bridge M11 Ebd	1,679	723	16,669	16,082	955	880
3.2	Madingley Rd on Over Bridge M11 Wbd	235	806	7,225	6,971	414	382
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Ebd	1,633	689	14,738	14,158	541	481
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Wbd	515	1,656	13,780	13,238	506	450
3.4	Madingley Rd - West of P&R Access Wbd	503	1,101	10,181	9,781	374	332
3.4	Madingley Rd - West of P&R Access Ebd	1,113	611	10,942	10,512	401	357
3.5	Madingley Rd - East of P&R Access Wbd	523	915	9,127	8,768	335	298
3.5	Madingley Rd - East of P&R Access Ebd	980	667	10,454	10,043	384	341
3.6	Madingley Rd - East of Proposed High Cross Access Ebd	1,178	788	12,478	11,988	458	407
3.6	Madingley Rd - East of Proposed High Cross Access Wbd	582	1,220	11,437	10,988	420	373
3.7	Madingley Rd - East of JJ Thomson Ave Ebd	1,030	1,096	13,494	12,963	495	441
3.7	Madingley Rd - East of JJ Thomson Ave Wbd	968	1,022	12,631	12,134	463	412
3.8	Madingley Rd - East of Clerk Maxwell Rd Ebd	978	1,233	14,031	13,479	515	458
3.8	Madingley Rd - East of Clerk Maxwell Rd Wbd	1,215	929	13,610	13,075	499	444
3.9	Madingley Rd - East of Storey's Way Ebd	911	1,128	12,937	12,428	475	422
3.9	Madingley Rd - East of Storey's Way Wbd	1,249	865	13,415	12,888	492	438
3.10	Madingley Rd - East of Grange Road Ebd	898	1,117	12,790	12,288	469	418
3.10	Madingley Rd - East of Grange Road Wbd	1,241	849	13,269	12,748	487	433
3.11	Madingley Rd - West of Queen's Rd / Northampton St R'bout Ebd	956	881	11,662	11,203	428	381
3.11	Madingley Rd - West of Queen's Rd / Northampton St R'bout Wbd	899	896	11,393	10,946	418	372
3.12	Northampton St - West of Pound Hill Ebd	539	943	9,407	9,038	345	307
3.12	Northampton St - West of Pound Hill Wbd	800	678	9,383	9,014	344	306
4.0	Huntingdon Rd - West of Proposed NWC HRW Access NWbd	535	1,267	11,437	10,987	420	373
4.0	Huntingdon Rd - West of Proposed NWC HRW Access SEbd	984	565	9,833	9,447	361	321
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College NWbd	436	777	7,701	7,398	283	251
4.1	Huntingdon Rd - South East of Grange Drive opposite Girton College SEbd	443	454	5,696	5,472	209	186
4.2	Huntingdon Rd - East of NWC HRW Access NWbd	662	1,271	12,269	11,787	450	401
4.2	Huntingdon Rd - East of NWC HRW Access SEbd	893	814	10,836	10,410	398	354
4.3	Huntingdon Rd - East of NIAB Access NWbd	615	1,358	12,524	12,031	459	409
4.3	Huntingdon Rd - East of NIAB Access SEbd	1,231	788	12,811	12,308	470	418
4.4	Huntingdon Rd - East of Storey's Way NWbd	591	1,237	11,604	11,148	426	379
4.4	Huntingdon Rd - East of Storey's Way SEbd	1,105	782	11,973	11,502	439	391
5.0	Barton Rd - West of Grantchester Rd Ebd	1,140	519	10,533	10,119	386	344
5.0	Barton Rd - West of Grantchester Rd Wbd	316	989	8,286	7,960	304	271

Flows found in 170601 - Junction Turning Movements

5.1	Barton Rd - East of Grantchester Rd Ebd	644	468	7,053	6,776	259	230
5.1	Barton Rd - East of Grantchester Rd Wbd	296	947	7,887	7,577	289	258
6.0	Queen's Rd - North of West Rd Nbd	630	856	9,429	9,059	346	308
6.0	Queen's Rd - North of West Rd Sbd	952	683	10,381	9,973	381	339
7.0	Histon Road - South of A14 Nbd	1,179	1,958	19,911	19,128	730	650
7.0	Histon Road - South of A14 Sbd	2,138	1,475	22,927	22,026	841	749
8.0	Grange Rd - South of Madingley Rd Nbd	210	224	2,259	2,144	110	95
8.0	Grange Rd - South of Madingley Rd Sbd	341	169	2,654	2,520	129	112
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Ebd	211	70	1,461	1,387	71	61
9.0	Storey's Way - between Madingley Rd and Huntingdon Rd Wbd	87	203	1,506	1,430	73	63
10.0	Girton Rd - North of Huntingdon Rd Nbd	156	383	2,804	2,662	136	118
10.0	Girton Rd - North of Huntingdon Rd Sbd	389	229	3,218	3,055	156	135
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Nbd	30	196	1,065	821	71	51
11.0	Proposed NIAB Access - between Huntingdon Rd and Histon Rd Sbd	196	67	1,236	953	82	60
11.1	Proposed Madingley Rd West Access to NWC Nbd	203	959	5,460	4,208	362	263
11.1	Proposed Madingley Rd West Access to NWC Sbd	942	304	5,853	4,510	388	282
11.2	Proposed Huntingdon Rd West Access to NWC Nbd	99	490	2,768	2,133	184	133
11.2	Proposed Huntingdon Rd West Access to NWC Sbd	541	111	3,065	2,362	203	148
11.3	Proposed Huntingdon Rd East Access to NWC Sbd	249	318	2,663	2,052	177	128
11.3	Proposed Huntingdon Rd East Access to NWC Nbd	240	340	2,724	2,099	181	131
12.0	Western Access to Madingley Rd Nbd	69	600	3,144	2,423	209	152
12.0	Western Access to Madingley Rd Sbd	582	94	3,177	2,448	211	153
12.1	High Cross Access to Madingley Rd Nbd	145	574	3,379	2,604	224	163
12.1	High Cross Access to Madingley Rd Sbd	758	124	4,145	3,194	275	200
12.2	JJ Thomson Ave Access to Madingley Rd Nbd	136	478	2,885	2,223	191	139
12.2	JJ Thomson Ave Access to Madingley Rd Sbd	560	96	3,083	2,375	205	149
12.3	Clerk Maxwell Rd Nbd - south of Car Park Access			65	52	4	3
12.3	Clerk Maxwell Rd Sbd - south of Car Park Access			62	50	4	3
12.4	Clerk Maxwell Rd Sbd - north of Car Park Access			1,036	826	69	52
12.4	Clerk Maxwell Rd Nbd - north of Car Park Access			1,056	841	70	53

Found in 170531 Asst of 24hr Movts on CMR



peterbrett

Link Reference Diagram

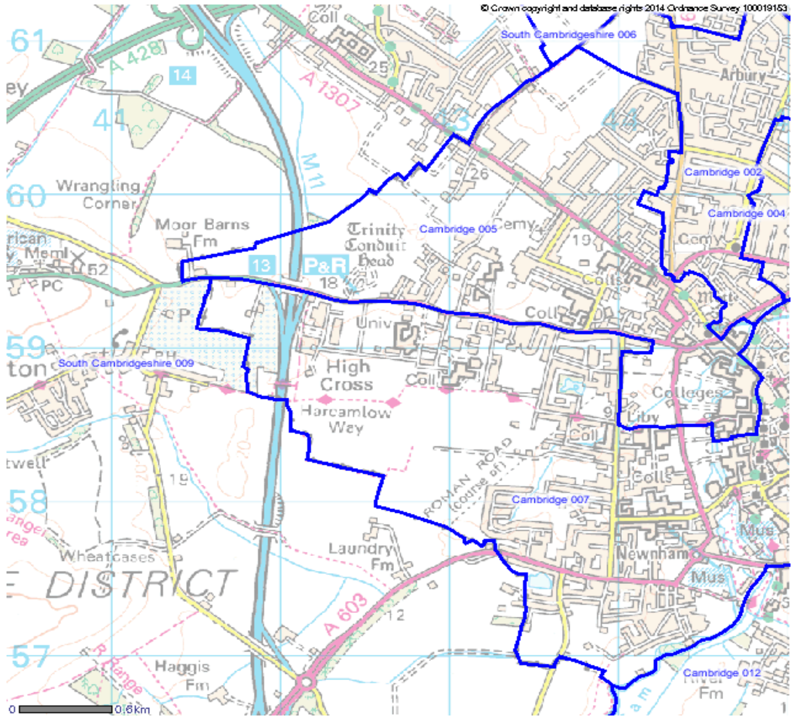
Appendix 10.4 TEMPRO growth factors for the Cambridge area

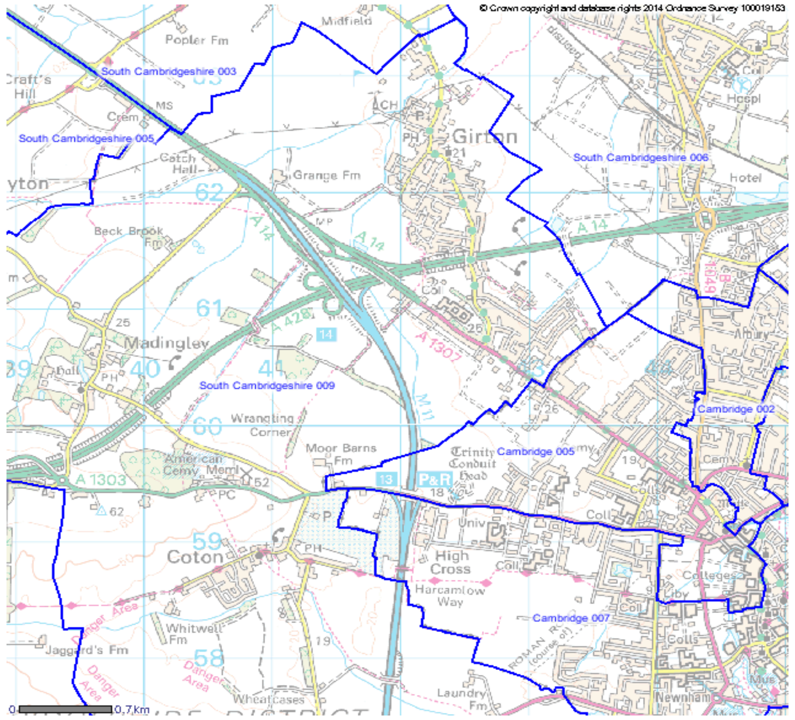
Job Number and Title Prepared By: M Balding

TEMPRO Growth factors

Dataset Selected:

		TEMPro Version 7.0.0 Growth Factors										
	Road Classification	Applied to (including)	2015-2016 Cambridge 005 (E02003723)		2015-2016 Cambridge 007 (E02003725)		2015-2016 Cambridge 009 (E02003727)		2014-2016 Cambridge 009 (E02003727)		2013-2016 Cambridge 007 (E02003725)	
			AM Peak (0700 - 0959)	PM Peak (1600 - 1859)	AM Peak (0700 - 0959)	PM Peak (1600 - 1859)	AM Peak (0700 - 0959)	PM Peak (1600 - 1859)	AM Peak (0700 - 0959)	PM Peak (1600 - 1859)	AM Peak (0700 - 0959)	PM Peak (1600 - 1859)
1	Urban Trunk	A428	1.0129	1.015	1.0151	1.0176			1.0425	1.0436		
2	Urban Principal Road	Madingley Road, Huntingdon Road, Barton Road, Northampton Road	1.0118	1.014	1.014	1.0166					1.041	1.0487
3	Urban Minor Road	Grange Road, Site Access	1.012	1.0141	1.0141	1.0167						
4	Rural Motorway	M11	1.0142	1.0164	1.0164	1.019			1.0454	1.0464		
5	Rural Trunk	A14	1.0151	1.0173	1.0173	1.0199	1.0239	1.0244	1.0465	1.0475		
6	Rural Principal	A1303 East of Madingley Mulch R'bout	1.0126	1.0147	1.0148	1.0173						
7	Rural Minor		1.0119	1.014	1.0141	1.0166						





ATKINS

Appendix 11.1 Human health receptors

Receptor	Location	Model Height (m)
Off-Site Receptors		
R1	1 Rhodegund Cottages, A14 Huntingdon Rd	1.5
R2	Hacker's Fruit Farm	1.5
R3	1 Huntingdon Road A14	1.5
R4	3-4 Elm Grange, A14 Huntingdon Rd	1.5
R5	118 Girton Road	4.5
R6	102 Girton Road	1.5
R7	91 Girton Road	1.5
R8	84 Girton Road	1.5
R9	2 Girton Road	1.5
R10	1 Huntingdon Road A14	1.5
R11	Nurseries, Huntington Road	1.5
R12	71- 81 Huntingdon Road	1.5
R13	141 Huntingdon Road	1.5
R14	139 Huntingdon Road	1.5
R15	1 to 81 Victoria Road	4.5
R16	38 Northampton Street	1.5
R17	9 Madingley Road	1.5
R18	11 Madingley Road	1.5
R19	19 to 39 Benians Ct	1.5
R20	23 Madingley Road	1.5
R21	53 Madingley Road	1.5
R22*	14 Conduit Head Road	1.5
R23*	Whitehouse, Conduit Head Road	1.5
R24*	2 Merton Hall, Madingley Road	1.5
R25*	36 Madingley Road	1.5
R26*	2 Lansdowne Road	1.5
R27*	2 Rosemary Cottages, Madingley Road	1.5
R28*	1 to 10 Refectory Farm Chalets	1.5
R29*	77 The Footpath	1.5
R30	3 St Neods Road	1.5
R31	Mill Farm, St Neods Rd	1.5
On-Site Receptors		
On Site 1*	Residential and Nursery (ground floor only)	1.5, 3, 4.5 and 6
On Site 2*	Residential	1.5, 3, 4.5 and 6
On Site 3*	Nursery (ground floor only)	1.5

Receptors marked with an * are used in the energy centre modelling

Appendix 11.2 Air quality model verification

Nitrogen dioxide

Most nitrogen dioxide is produce in the atmosphere by the reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emission of nitrogen oxides (NOx = NO + NO2). The model has been run to predict the 2016 annual mean road-NO_x contribution at seven roadside and kerbside monitoring locations (both automatic and diffusion tubes) in close proximity to the proposed development and within the two closest declared AQMAs (described in Table 10.11). Table 10.2.1 below describes the heights at which the monitoring locations were modelled.

Table 11.2.1 Modelled Heights of Monitoring Locations

ID	Site Type	Within AQMA	Model Height (m)
Automatic Sites (SCDC)			
Girton	Roadside	N	1.5
Diffusion Tubes (SCDC)			
1 Catchall Farm Cottages	Roadside	Y	1.5
Hackers Fruit Farm	Roadside	Y	1.5
Diffusion Tubes (CCC)			
Madingley Road	Kerbside	N	1
Histon Road 1 NEW	Kerbside	N	1.5
Huntingdon Road 1	Roadside	N	1
Huntingdon Road 2	Roadside	N	1

The model output of road-NO_x has been compared with the 'measured' road-NO_x, which was calculated from the measured NO_2 concentrations and the adjusted background NO_2 concentrations within the NO_x from NO_2 calculator published by Defra.

A primary adjustment factor was determined as the slope of the best fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure 11.2.1). This factor was then applied to the modelled road-NO_x concentration for each monitoring Site to provide adjusted modelled road-NO_x concentrations. The total NO_2 concentrations were then determined by combining the adjusted modelled road-NO_x concentrations with the predicted background NO_2 concentration within the NO_x from NO_2 calculator. A secondary adjustment factor was finally calculated as the slope of the best fit line applied to the adjusted data and forced through zero (Figure 11.2.2).

The following primary and secondary adjustment factors have been applied to all modelled NO_2 data:

- Primary adjustment factor: 1.9381
- Secondary adjustment factor: 1.0002

The results imply that the model was under-predicting the road-NO_x contribution. This is a common experience with this and most other models. The final NO_2 adjustment is minor.

Figure 11.2.3 compares final adjusted modelled total NO_2 at each of the monitoring sites, to measured total NO_2, and shows the 1:1 relationship, as well as ±10% and ±25% of the 1:1 line. The majority of the points lie within the ±25% line with the exception of monitoring location Madingley Road, which measured 37.2 µg/m³ in 2016. This monitoring point was left within the verification as it provided a slightly higher verification factor that otherwise would have been obtained without the monitoring point. The reasons for the under-prediction at this point could not be ascertained.

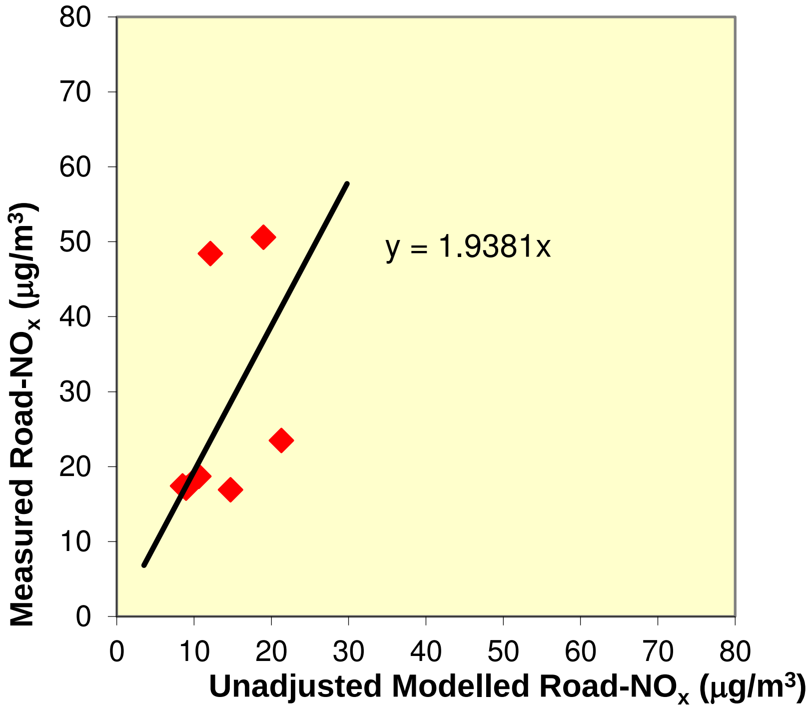


Figure 11.2.1: Comparison of Measured Road-NO_x with Unadjusted Modelled Road-NO_x Concentrations

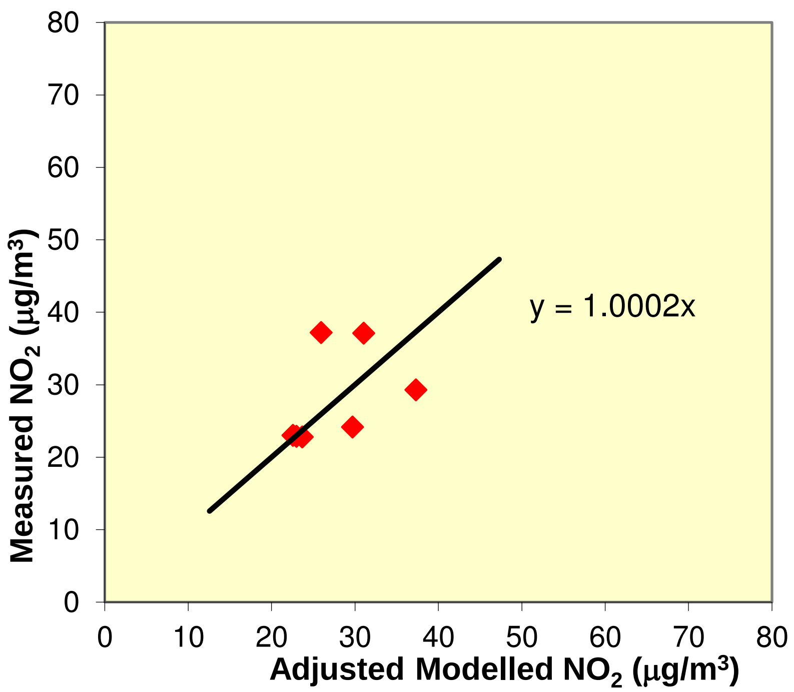


Figure 11.2.2: Comparison of Measured NO_2 with Adjusted Modelled NO_2 Concentrations

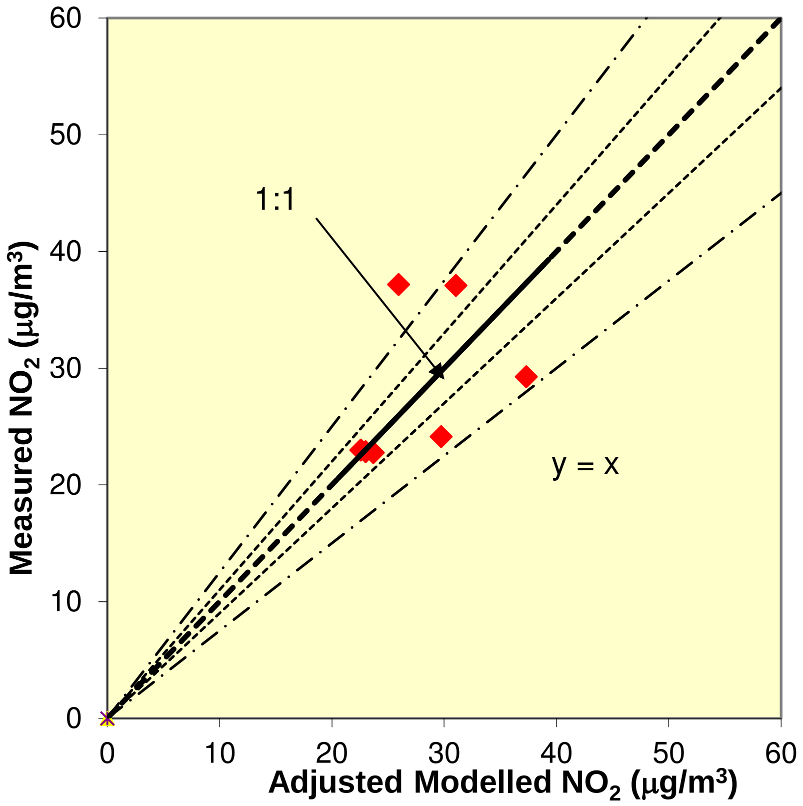


Figure 11.2.3: Comparison of Measured NO_2 with Fully Adjusted Modelled NO_2 Concentrations

PM_{10} and $PM_{2.5}$

Automatic monitors Girton and Impington (A14) undertake PM_{10} monitoring. However, as the Impington monitor measured PM_{10} concentrations below the background in 2016 and the Girton monitor was only just above the background, it was considered conservative to apply the primary adjustment factor calculated for NO_2 concentrations to the modelled-road PM_{10} concentrations.

The Girton monitor also undertakes $PM_{2.5}$ monitoring. Results from 2016 were used to calculate a verification factor for $PM_{2.5}$. This resulted in a verification factor of 3.2933 which was used to adjust modelled-road $PM_{2.5}$ concentrations.

Appendix 11.3 Traffic data

Table 11.3.1 Traffic data used for air quality modelling

Road Link	Description	2016 Baseline		2021 Without Development		2021 With Development (Phase I)		2031 Baseline with Phase I		2031 With Full Development	
		AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV
1.0	M11 – J12 – J13	87,403	15.53	93,277	15.53	93,857	15.53	97,061	15.53	99,529	15.53
1.1	M11 – J13 – J14	64,141	15.53	67,076	15.53	66,632	15.53	69,310	15.53	68,667	15.53
1.2	M11 between A14 Ebd on-slip / Huntington Road on slip	46,172	15.53	48,460	15.53	48,091	15.53	50,438	15.53	49,910	15.53
1.3	M11 J13 off-slip	17,265	15.53	20,208	15.53	21,229	15.53	21,742	15.53	24,865	15.53
2.0	A14 West of J30 (Bar Hill)	75,202	18.33	76,326	18.33	77,674	18.33	77,544	18.33	80,828	18.33
2.1	A14 North West of M11 J154	73,408	18.33	74,906	18.33	79,774	18.33	77,436	18.33	86,421	18.33
2.2	A14 West of J32 Interchange	76,924	18.33	79,916	18.33	79,502	18.33	82,445	18.33	81,871	18.33
2.3	A428 – West of M11 J14	22,285	18.33	23,008	18.33	22,922	18.33	24,131	18.33	23,908	18.33
3.0	A1303 East of Madingley Mulch Roundabout	18,031	5.47	19,682	5.47	20,050	5.47	21,309	5.47	22,480	5.47
3.1	Madingley Rd – East of Cambrirdge Rd Crossroads	19,510	5.47	19,762	5.47	20,168	5.47	21,396	5.47	22,707	5.47
3.2	Madingley Rd on Over Bridge M11	17,000	5.47	17,976	5.47	19,150	5.47	19,724	5.47	23,053	5.47
3.3	Madingley Rd between M11 Sbd On Slip – Proposed Madingley Road West Access	19,311	3.4	21,109	3.4	22,611	3.4	22,859	3.4	27,397	3.4
3.4	Madingley Rd – West of P&R Access	19,311	3.4	21,109	3.4	22,611	3.4	22,859	3.4	27,397	3.4
3.5	Madingley Rd – East of P&R Access	17,835	3.4	19,634	3.4	21,957	3.4	21,384	3.4	18,811	3.4
3.6	Madingley Rd – East of Proposed High Cross Access	15,573	3.4	17,207	3.4	21,293	3.4	18,634	3.4	22,976	3.4
3.7	Madingley Rd – East of JJ Thomson Ave	17,085	3.4	18,642	3.4	20,604	3.4	19,886	3.4	25,098	3.4
3.8	Madingley Rd – East of Clerk Maxwell Rd	16,805	3.4	18,416	3.4	21,438	3.4	19,660	3.4	26,554	3.4
3.9	Madingely Rd – East of Storey's Way	15,112	3.4	17,000	3.4	20,230	3.4	18,213	3.4	25,316	3.4
3.10	Madingley Rd – East of Grange Road	15,112	3.4	16,928	3.4	20,040	3.4	18,123	3.4	25,036	3.4
3.11	Madingley Rd – West of Queen's Rd / Northampton Road Roundabout	16,317	3.4	18,806	3.4	19,223	3.4	19,660	3.4	22,149	3.4
3.12	Northampton Rd – West of Pound Hill	13,706	3.4	15,725	3.4	15,793	3.4	16,664	3.4	18,052	3.4
4.0	Huntingdon Rd- West of Proposed NWC HRW Access	10,644	3.4	13,874	3.4	15,840	3.4	15,410	3.4	20,434	3.4
4.1	Huntingdon Rd – South East of Grange Drive opposite Girton College	10,644	3.4	11,746	3.4	11,613	3.4	13,057	3.4	12,870	3.4
4.2	Huntingdon Rd – East of NWC HRW Access	14,955	3.4	20,294	3.4	19,716	3.4	22,367	3.4	22,197	3.4
4.3	Huntingdon Rd – East of NIAB Access	17,671	3.4	23,062	3.4	22,315	3.4	25,215	3.4	24,339	3.4
4.4	Huntingdon Rd – East of Storey's Way	16,411	3.4	21,790	3.4	20,891	3.4	23,882	3.4	22,650	3.4
6.0	Queen's Rd – North of West Road	14,928	3.4	15,788	3.4	16,982	3.4	16,508	3.4	19,031	3.4
7.0	Histon Road – South of A14	34,192	3.4	36,331	3.4	38,542	3.4	38,014	3.4	41,154	3.4

Road Link	Description	2016 Baseline		2021 Without Development		2021 With Development (Phase I)		2031 Baseline with Phase I		2031 With Full Development	
		AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV
8.0	Grange Road – South of Madingley Road	4,292	4.43	4,430	4.43	4,512	4.43	4,524	4.43	4,664	4.43
9.0	Storey's Way – between Madingley Rd and Huntingdon Road	3,215	4.43	2,800	4.43	2,799	4.43	2,825	4.43	2,817	4.43
10.0	Girton Road – North of Huntingdon Road	5,019	4.43	5,446	4.43	5,476	4.43	5,535	4.43	5,717	4.43
11.0	Proposed NIAB Access – between Huntingdon Rd and Histon Rd	0	0	768	6.26	827	6.26	1,626	6.26	1,774	6.26
11.1	Proposed Madingley Rd West Access to NWC	0	0	3,650	6.26	5,282	6.26	4,530	6.26	8,718	6.26
11.2	Proposed Huntingdon Rd West Access to NWC	0	0	1,260	6.26	2,510	6.26	1,409	6.26	4,494	6.26
11.3	Proposed Huntingdon Rd East Access to NWC	0	0	3,292	6.26	2,947	6.26	4,190	6.26	4,151	6.26
12.0	Western Access to Madingley Rd	0	0	0	0	0	0	0	0	4,870	6.26
12.1	High Cross Access to Madingley Rd	2,223	6.26	1,750	6.26	5,425	6.26	1,750	6.26	5,798	6.26
12.2	JJ Thomson Ave Access to Madingley Rd	2,289	6.26	2,365	6.26	2,347	6.26	2,365	6.26	4,599	6.26
12.3	Clerk Maxwell Rd	322	6.26	312	6.26	102	6.26	312	6.26	102	6.26

Appendix 11.5 Predicted baseline concentrations

Predicted Concentrations of NO_2, PM_{10} and $PM_{2.5}$ at Receptors in 2016, 2021 and 2031

Table 11.5.1 Human Health Receptors

Receptor	Annual Mean (µg/m3)								
	2016 Baseline			2021 Without Development			2031 Without Full Development		
	NO2	PM10	PM2.5	NO2	PM10	PM2.5	NO2	PM10	PM2.5
R1	31.9	20.5	14.8	26.7	20.0	14.2	17.9	19.3	13.4
R2	29.1	19.5	14.1	24.4	19.0	13.5	16.5	18.4	12.8
R3	28.9	21.1	14.8	24.4	20.7	14.3	16.6	20.0	13.5
R4	29.5	20.1	14.3	26.2	19.8	14.0	18.2	19.2	13.2
R5	29.4	20.0	14.4	25.2	19.6	13.9	17.1	18.9	13.2
R6	29.2	20.0	14.4	25.0	19.6	13.9	17.0	18.9	13.2
R7	21.9	18.8	13.1	19.2	18.5	12.8	13.7	17.9	12.2
R8	21.7	18.8	13.1	19.1	18.5	12.8	13.6	17.9	12.2
R9	19.6	17.7	12.5	17.5	17.5	12.2	12.6	17.0	11.7
R10	22.2	18.1	12.9	19.8	17.9	12.6	14.0	17.4	12.1
R11	17.5	17.5	12.3	16.1	17.4	12.1	12.0	16.9	11.6
R12	19.9	16.8	12.1	19.1	16.8	12.1	13.6	16.3	11.6
R13	18.3	16.7	12.0	16.7	16.5	11.8	12.4	16.0	11.3
R14	18.6	16.7	12.0	16.8	16.5	11.8	12.4	16.0	11.3
R15	27.0	17.5	13.0	25.1	17.4	12.8	18.2	16.9	12.2
R16	23.4	16.5	12.1	21.4	16.2	11.9	16.1	15.7	11.3
R17	23.2	16.9	12.4	21.1	16.7	12.1	15.8	16.1	11.5
R18	21.9	16.7	12.1	19.9	16.5	11.9	15.2	15.9	11.3
R19	18.0	16.7	11.9	16.2	16.4	11.7	12.1	15.9	11.2
R20	18.6	16.7	12.0	16.7	16.5	11.7	12.3	15.9	11.2
R21	16.9	16.4	11.7	15.2	16.2	11.4	11.5	15.7	11.0
R22	18.6	17.9	12.5	16.6	17.7	12.3	12.2	17.2	11.8
R23	18.3	17.8	12.5	16.4	17.6	12.3	12.0	17.1	11.8
R24	17.3	17.6	12.3	15.5	17.4	12.0	11.5	16.9	11.5
R25	19.5	18.1	12.7	17.5	17.9	12.5	12.7	17.4	12.0
R26	19.6	18.1	12.7	17.5	17.9	12.5	12.7	17.4	12.0
R27	19.1	17.9	12.6	17.1	17.7	12.4	12.5	17.2	11.9
R28	15.5	16.1	11.4	13.7	15.8	11.2	10.1	15.3	10.7
R29	14.8	17.1	11.8	13.2	16.8	11.6	10.0	16.3	11.1
R30	31.9	16.7	12.1	16.3	16.4	11.7	11.8	15.9	11.2
R31	29.1	16.6	11.9	15.6	16.3	11.7	11.4	15.8	11.2
On site 1A	13.7	17.3	11.8	12.3	17.0	11.6	9.5	16.5	11.1
On site 1B	13.7	17.3	11.8	12.3	17.0	11.6	9.5	16.5	11.1
On site 1C	13.7	17.3	11.8	12.3	17.0	11.6	9.5	16.5	11.1
On site 1D	13.7	17.3	11.8	12.3	17.0	11.6	9.5	16.5	11.1
On site 2A	13.6	17.3	11.8	12.3	17.0	11.6	9.4	16.5	11.1
On site 2B	13.6	17.3	11.8	12.3	17.0	11.6	9.4	16.5	11.1
On site 2C	13.6	17.3	11.8	12.3	17.0	11.6	9.4	16.5	11.1
On site 2D	13.6	17.3	11.8	12.3	17.0	11.6	9.4	16.5	11.1
On site 3A	13.8	17.3	11.8	12.4	17.0	11.6	9.5	16.5	11.1
Objectives	40	40	25	40	40	25	40	40	25

Table 11.5.2 Ecological Receptors (2016)

Receptor and Distance in Habitat	Distance from kerb (m)	Total NOx (μg/m3)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr)
Madingley Wood SSSI				
T1- 0m	0	43.8	31.6	2.468
T1- 5m	5	32.2	30.0	2.351
T1- 10m	10	27.3	29.3	2.300
T1- 15m	15	24.7	28.9	2.272
T1- 20m	20	23.0	28.6	2.254
T1- 30m	30	21.0	28.3	2.232
T1- 40m	40	19.9	28.2	2.221
T1- 50m	50	19.2	28.0	2.213
T1- 75m	75	18.2	27.9	2.202
T1- 100m	100	17.6	27.8	2.196
T1- 125m	125	17.3	27.7	2.192
T1- 150m	150	17.0	27.7	2.189
T1- 175m	175	16.9	27.7	2.187
T1- 200m	200	16.7	27.7	2.186
CRITICAL LEVEL / LOAD		30	15 - 20	1.859
Exceedences of the Critical Level / Load in bold				

Table 11.5.3 Ecological Receptors (2021)

Receptor and Distance in Habitat	Distance from kerb (m)	Total NOx (μg/m3)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)
Madingley Wood SSSI				
T1- 0m	0	38.2	31.1	2.430
T1- 5m	5	28.2	29.6	2.327
T1- 10m	10	24.0	29.0	2.282
T1- 15m	15	21.7	28.7	2.258
T1- 20m	20	20.3	28.5	2.243
T1- 30m	30	18.6	28.2	2.224
T1- 40m	40	17.7	28.1	2.214
T1- 50m	50	17.1	28.0	2.207
T1- 75m	75	16.2	27.8	2.197
T1- 100m	100	15.7	27.7	2.192
T1- 125m	125	15.4	27.7	2.189
T1- 150m	150	15.2	27.7	2.186
T1- 175m	175	15.1	27.6	2.185
T1- 200m	200	15.0	27.6	2.183
CRITICAL LEVEL / LOAD		30	15 - 20	1.859
Exceedences of the Critical Level / Load in bold				

Table 11.5.4 Ecological receptors (2031)

Receptor and Distance in Habitat	Distance from kerb (m)	Total NOx (µg/m3)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)
Madingley Wood SSSI				
T1- 0m	0	25.8	29.7	2.333
T1- 5m	5	19.6	28.8	2.268
T1- 10m	10	17.0	28.4	2.239
T1- 15m	15	15.6	28.2	2.224
T1- 20m	20	14.7	28.1	2.215
T1- 30m	30	13.7	27.9	2.203
T1- 40m	40	13.1	27.8	2.197
T1- 50m	50	12.7	27.8	2.192
T1- 75m	75	12.2	27.7	2.186
T1- 100m	100	11.9	27.6	2.183
T1- 125m	125	11.7	27.6	2.181
T1- 150m	150	11.6	27.6	2.180
T1- 175m	175	11.5	27.6	2.179
T1- 200m	200	11.4	27.6	2.178
CRITICAL LEVEL / LOAD		30	15 - 20	1.859
Exceedences of the Critical Level / Load in bold				

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Appendix 11.6 Predicted future concentrations (human health receptors)

Table 11.6.1 Predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ at existing receptors in 2021

Receptor	Annual Mean (µg/m3)					
	2021 Without Development			2021 With Development (Interim Scenario)		
	NO2	PM10	PM2.5	NO2	PM10	PM2.5
R1	26.7	20.0	14.2	26.9	20.0	14.2
R2	24.4	19.0	13.5	25.2	19.1	13.7
R3	24.4	20.7	14.3	25.0	20.7	14.4
R4	26.2	19.8	14.0	26.7	19.9	14.1
R5	25.2	19.6	13.9	25.2	19.6	13.9
R6	25.0	19.6	13.9	25.0	19.6	13.9
R7	19.2	18.5	12.8	19.2	18.5	12.8
R8	19.1	18.5	12.8	19.1	18.5	12.8
R9	17.5	17.5	12.2	17.5	17.5	12.2
R10	19.8	17.9	12.6	19.8	17.9	12.6
R11	16.1	17.4	12.1	16.1	17.3	12.1
R12	19.1	16.8	12.1	18.9	16.8	12.1
R13	16.7	16.5	11.8	16.7	16.5	11.8
R14	16.8	16.5	11.8	16.8	16.5	11.8
R15	25.1	17.4	12.8	25.2	17.4	12.8
R16	21.4	16.2	11.9	21.6	16.3	11.9
R17	21.1	16.7	12.1	21.7	16.8	12.2
R18	19.9	16.5	11.9	20.3	16.5	12.0
R19	16.2	16.4	11.7	16.7	16.5	11.8
R20	16.7	16.5	11.7	17.2	16.6	11.8
R21	15.2	16.2	11.4	15.5	16.2	11.5
R22	16.6	17.7	12.3	17.3	17.8	12.5
R23	16.4	17.6	12.3	17.1	17.8	12.4
R24	15.5	17.4	12.0	16.0	17.5	12.1
R25	17.5	17.9	12.5	18.4	18.1	12.7
R26	17.5	17.9	12.5	18.4	18.1	12.7
R27	17.1	17.7	12.4	17.9	17.9	12.5
R28	13.7	15.8	11.2	13.7	15.8	11.2
R29	13.2	16.8	11.6	13.2	16.8	11.6
R30	16.3	16.4	11.7	16.4	16.4	11.8
R31	15.6	16.3	11.7	15.7	16.4	11.7
On site 1A	12.3	17.0	11.6	12.4	17.0	11.6
On site 1B	12.3	17.0	11.6	12.4	17.0	11.6
On site 1C	12.3	17.0	11.6	12.4	17.0	11.6
On site 1D	12.3	17.0	11.6	12.4	17.0	11.6
On site 2A	12.3	17.0	11.6	12.3	17.0	11.6
On site 2B	12.3	17.0	11.6	12.3	17.0	11.6
On site 2C	12.3	17.0	11.6	12.3	17.0	11.6
On site 2D	12.3	17.0	11.6	12.3	17.0	11.6
On site 3A	12.4	17.0	11.6	12.4	17.0	11.6
Objectives	40	40	25	40	40	25

Table 11.6.2 Change in predicted concentrations brought about by the Proposed Development in 2021

Receptor	Annual Mean (µg/m3)		
	NO2	PM10	PM2.5
R1	0.46	0.03	0.03
R2	1.57	0.10	0.12
R3	1.24	0.08	0.10
R4	1.06	0.10	0.10
R5	-0.04	-0.01	0.00
R6	-0.03	0.00	0.00
R7	0.02	0.00	0.00
R8	0.03	0.00	0.00
R9	0.00	0.00	0.00
R10	-0.08	-0.01	-0.01
R11	-0.09	-0.01	-0.01
R12	-0.31	-0.03	-0.03

Receptor	Annual Mean (µg/m3)		
	NO2	PM10	PM2.5
R13	-0.12	-0.02	-0.01
R14	-0.11	-0.01	-0.01
R15	0.13	0.01	0.01
R16	0.42	0.04	0.04
R17	1.20	0.11	0.11
R18	0.84	0.08	0.08
R19	0.92	0.11	0.10
R20	1.05	0.11	0.11
R21	0.49	0.05	0.05
R22	1.35	0.17	0.17
R23	1.24	0.16	0.15
R24	0.84	0.10	0.10
R25	1.71	0.22	0.21
R26	1.72	0.22	0.21
R27	1.55	0.18	0.18
R28	0.10	0.01	0.01
R29	0.03	0.00	0.00
R30	0.22	0.02	0.02
R31	0.18	0.02	0.02
On site 1A	0.09	0.01	0.01
On site 1B	0.09	0.01	0.01
On site 1C	0.09	0.01	0.01
On site 1D	0.09	0.01	0.01
On site 2A	0.07	0.01	0.01
On site 2B	0.07	0.01	0.01
On site 2C	0.07	0.01	0.01
On site 2D	0.07	0.01	0.01
On site 3A	0.07	0.01	0.01
Based on unrounded numbers			

Table 11.6.3 Predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ at existing receptors in 2031

Receptor	Annual Mean (µg/m3)					
	2031 Without Development			2031 With Full Development		
	NO2	PM10	PM2.5	NO2	PM10	PM2.5
R1	17.9	19.3	13.4	18.2	19.3	13.5
R2	16.5	18.4	12.8	17.3	18.5	13.0
R3	16.6	20.0	13.5	17.2	20.2	13.7
R4	18.2	19.2	13.2	19.0	19.4	13.5
R5	17.1	18.9	13.2	17.1	19.0	13.2
R6	17.0	18.9	13.2	17.0	19.0	13.2
R7	13.7	17.9	12.2	13.7	18.0	12.2
R8	13.6	17.9	12.2	13.6	17.9	12.2
R9	12.6	17.0	11.7	12.6	17.0	11.7
R10	14.0	17.4	12.1	14.0	17.4	12.1
R11	12.0	16.9	11.6	12.0	16.9	11.6
R12	13.6	16.3	11.6	13.6	16.3	11.6
R13	12.4	16.0	11.3	12.3	16.0	11.3
R14	12.4	16.0	11.3	12.4	16.0	11.3
R15	18.2	16.9	12.2	18.3	16.9	12.3
R16	16.1	15.7	11.3	16.5	15.8	11.4
R17	15.8	16.1	11.5	16.5	16.4	11.7
R18	15.2	15.9	11.3	15.7	16.1	11.5
R19	12.1	15.9	11.2	12.7	16.1	11.4
R20	12.3	15.9	11.2	13.0	16.2	11.4
R21	11.5	15.7	11.0	11.8	15.8	11.1
R22	12.2	17.2	11.8	12.6	17.3	12.0
R23	12.0	17.1	11.8	12.4	17.3	11.9
R24	11.5	16.9	11.5	11.8	17.0	11.6
R25	12.7	17.4	12.0	13.2	17.6	12.2
R26	12.7	17.4	12.0	13.3	17.6	12.2
R27	12.5	17.2	11.9	13.0	17.4	12.0
R28	10.1	15.3	10.7	10.2	15.3	10.7
R29	10.0	16.3	11.1	10.0	16.3	11.1
R30	11.8	15.9	11.2	12.0	16.0	11.3

Receptor	Annual Mean (µg/m3)					
	2031 Without Development			2031 With Full Development		
	NO2	PM10	PM2.5	NO2	PM10	PM2.5
R31	11.4	15.8	11.2	11.6	15.9	11.2
On site 1A	9.5	16.5	11.1	9.6	16.5	11.1
On site 1B	9.5	16.5	11.1	9.5	16.5	11.1
On site 1C	9.5	16.5	11.1	9.5	16.5	11.1
On site 1D	9.5	16.5	11.1	9.5	16.5	11.1
On site 2A	9.4	16.5	11.1	9.5	16.5	11.1
On site 2B	9.4	16.5	11.1	9.5	16.5	11.1
On site 2C	9.4	16.5	11.1	9.5	16.5	11.1
On site 2D	9.4	16.5	11.1	9.5	16.5	11.1
On site 3A	9.5	16.5	11.1	9.6	16.5	11.1
Objectives	40	40	25	40	40	25

Table 11.6.4 Change in predicted concentrations brought about by the Proposed Development in 2031

Receptor	Annual Mean (µg/m3)		
	NO2	PM10	PM2.5
R1	0.07	0.07	0.07
R2	0.18	0.18	0.18
R3	0.14	0.14	0.14
R4	0.22	0.22	0.22
R5	0.00	0.00	0.00
R6	0.01	0.01	0.01
R7	0.01	0.01	0.01
R8	0.01	0.01	0.01
R9	0.01	0.01	0.01
R10	0.00	0.00	0.00
R11	0.00	0.00	0.00
R12	0.00	0.00	0.00
R13	-0.01	-0.01	-0.01
R14	-0.01	-0.01	-0.01
R15	0.02	0.02	0.02
R16	0.11	0.11	0.11
R17	0.22	0.22	0.22
R18	0.15	0.15	0.15
R19	0.21	0.21	0.21
R20	0.22	0.22	0.22
R21	0.11	0.11	0.11
R22	0.17	0.17	0.17
R23	0.16	0.16	0.16
R24	0.11	0.11	0.11
R25	0.21	0.21	0.21
R26	0.21	0.21	0.21
R27	0.18	0.18	0.18
R28	0.03	0.03	0.03
R29	0.01	0.01	0.01
R30	0.06	0.06	0.06
R31	0.05	0.05	0.05
On site 1A	0.06	0.02	0.02
On site 1B	0.05	0.02	0.02
On site 1C	0.05	0.02	0.02
On site 1D	0.06	0.02	0.02
On site 2A	0.05	0.01	0.01
On site 2B	0.05	0.01	0.01
On site 2C	0.05	0.01	0.01
On site 2D	0.04	0.01	0.01
On site 3A	0.04	0.01	0.01
Based on unrounded numbers			

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Appendix 11.7 Predicted future concentrations (ecological receptors)

Table 11.7.1 Predicted concentrations at ecological receptors in 2021 without and with the Proposed Development in place

Receptor and Distance in Habitat	Distance from kerb (m)	2021 Without Development			2021 With Development (Interim Scenario)		
		Total NOx (µg/m3)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr)	Total NOx (µg/m3)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr)
Madingley Wood SSSI							
T1- 0m	0	38.2	31.1	2.430	38.6	31.1	2.435
T1- 5m	5	28.2	29.6	2.327	28.5	29.7	2.330
T1- 10m	10	24.0	29.0	2.282	24.2	29.0	2.284
T1- 15m	15	21.7	28.7	2.258	21.9	28.7	2.260
T1- 20m	20	20.3	28.5	2.243	20.4	28.5	2.244
T1- 30m	30	18.6	28.2	2.224	18.7	28.2	2.225
T1- 40m	40	17.7	28.1	2.214	17.8	28.1	2.215
T1- 50m	50	17.1	28.0	2.207	17.1	28.0	2.207
T1- 75m	75	16.2	27.8	2.197	16.2	27.8	2.198
T1- 100m	100	15.7	27.7	2.192	15.8	27.8	2.192
T1- 125m	125	15.4	27.7	2.189	15.4	27.7	2.189
T1- 150m	150	15.2	27.7	2.186	15.2	27.7	2.186
T1- 175m	175	15.1	27.6	2.185	15.1	27.6	2.185
T1- 200m	200	15.0	27.6	2.183	15.0	27.6	2.184
CRITICAL LEVEL / LOAD		30	15 - 20	1.859	30	15 - 20	1.859
Exceedences of the Critical Level / Load in bold Exceedences of the objectives in bold.							

Table 11.7.2 Predicted Proposed Development contribution in 2021

Receptor and Distance in Habitat	Distance from kerb (m)	2021 Scheme Contribution					
		Total NOx (µg/m3)		Nitrogen Deposition (kgN/ha/yr)		Acid Deposition (keqN/ha/yr)	
		NOx	%	N Deposition	%	Acid Deposition	%
Madingley Wood SSSI							
T1- 0m	0	0.4	1.5	0.06	0.4	0.005	0.2
T1- 5m	5	0.3	0.9	0.04	0.3	0.003	0.2
T1- 10m	10	0.2	0.6	0.03	0.2	0.002	0.1
T1- 15m	15	0.1	0.5	0.02	0.1	0.001	0.1
T1- 20m	20	0.1	0.4	0.02	0.1	0.001	0.1
T1- 30m	30	0.1	0.3	0.01	0.1	0.001	0.1
T1- 40m	40	0.1	0.2	0.01	0.1	0.001	0.0
T1- 50m	50	0.1	0.2	0.01	0.1	0.001	0.0
T1- 75m	75	0.0	0.1	0.01	0.0	0.000	0.0
T1- 100m	100	0.0	0.1	0.01	0.0	0.000	0.0
T1- 125m	125	0.0	0.1	0.01	0.0	0.000	0.0
T1- 150m	150	0.0	0.1	0.00	0.0	0.000	0.0
T1- 175m	175	0.0	0.1	0.00	0.0	0.000	0.0
T1- 200m	200	0.0	0.1	0.00	0.0	0.000	0.0
Exceedences of 1% of the critical level/ load highlighted in bold							

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Table 11.7.3 Predicted concentrations at ecological receptors in 2031 without and with the Proposed Development in place

Receptor and Distance in Habitat	**Distance from kerb (m)**	**2031 Without Development**			**2031 With Full Development**		
		Total NOx (µg/m3)	**Nitrogen Deposition (kgN/ha/yr)**	**Acid Deposition (keqN/ha/yr)**	**Total NOx (µg/m3)**	**Nitrogen Deposition (kgN/ha/yr)**	**Acid Deposition (keq/ha/yr)**
Madingley Wood SSSI							
T1- 0m	0	25.8	29.7	2.333	26.6	29.8	2.342
T1- 5m	5	19.6	28.8	2.268	20.1	28.9	2.273
T1- 10m	10	17.0	28.4	2.239	17.3	28.5	2.243
T1- 15m	15	15.6	28.2	2.224	15.9	28.2	2.227
T1- 20m	20	14.7	28.1	2.215	14.9	28.1	2.217
T1- 30m	30	13.7	27.9	2.203	13.8	27.9	2.205
T1- 40m	40	13.1	27.8	2.197	13.2	27.8	2.198
T1- 50m	50	12.7	27.8	2.192	12.8	27.8	2.193
T1- 75m	75	12.2	27.7	2.186	12.2	27.7	2.187
T1- 100m	100	11.9	27.6	2.183	11.9	27.6	2.184
T1- 125m	125	11.7	27.6	2.181	11.7	27.6	2.182
T1- 150m	150	11.6	27.6	2.180	11.6	27.6	2.180
T1- 175m	175	11.5	27.6	2.179	11.5	27.6	2.179
T1- 200m	200	11.4	27.6	2.178	11.4	27.6	2.178
CRITICAL LEVEL / LOAD		30	15 - 20	0.214 – 1.860	30	15 - 20	1.859
Exceedences of the Critical Level / Load in bold Exceedences of the objectives in bold.							

Table 11.7.4 Predicted Proposed Development contribution in 2031

Receptor and Distance in Habitat	Distance from kerb (m)	2021 Scheme Contribution					
		Total NOx (µg/m3)		Nitrogen Deposition (kgN/ha/yr)		Acid Deposition (keqN/ha/yr)	
		NOx	%	N Deposition	%	Acid Deposition	%
Madingley Wood SSSI							
T1- 0m	0	0.8	2.7	0.12	0.8	0.008	0.5
T1- 5m	5	0.5	1.6	0.07	0.5	0.005	0.3
T1- 10m	10	0.3	1.1	0.05	0.3	0.004	0.2
T1- 15m	15	0.3	0.9	0.04	0.3	0.003	0.2
T1- 20m	20	0.2	0.7	0.03	0.2	0.002	0.1
T1- 30m	30	0.2	0.5	0.02	0.2	0.002	0.1
T1- 40m	40	0.1	0.4	0.02	0.1	0.001	0.1
T1- 50m	50	0.1	0.4	0.01	0.1	0.001	0.1
T1- 75m	75	0.1	0.3	0.01	0.1	0.001	0.0
T1- 100m	100	0.1	0.2	0.01	0.1	0.001	0.0
T1- 125m	125	0.1	0.2	0.01	0.1	0.001	0.0
T1- 150m	150	0.0	0.1	0.01	0.1	0.001	0.0
T1- 175m	175	0.0	0.1	0.01	0.0	0.000	0.0
T1- 200m	200	0.0	0.1	0.01	0.0	0.000	0.0

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Appendix 11.8 Predicted energy centre emissions concentrations

The predicted Process Contribution (PC) at human health receptors

Table 11.8.1 Maximum NO_2 process contribution (PC) at human health receptors

Receptor	Averaging	Units	PC	EAL	%EAL
22	Annual	µg/m3	0.3	40	0.82
	Hourly		45.1	200	22.5
23	Annual	µg/m3	0.4	40	1.02
	Hourly		45.1	200	22.5
24	Annual	µg/m3	0.4	40	1.02
	Hourly		45.1	200	22.5
25	Annual	µg/m3	0.5	40	1.16
	Hourly		36.0	200	18.0
26	Annual	µg/m3	0.6	40	1.45
	Hourly		36.2	200	18.1
27	Annual	µg/m3	0.6	40	1.58
	Hourly		37.2	200	18.6
28	Annual	µg/m3	0.6	40	1.46
	Hourly		20.2	200	10.1
29	Annual	µg/m3	0.2	40	0.44
	Hourly		13.1	200	6.5
1A	Annual	µg/m3	0.3	40	0.79
	Hourly		45.6	200	22.8
1B	Annual	µg/m3	0.3	40	0.79
	Hourly		45.6	200	22.8
1C	Annual	µg/m3	0.3	40	0.79
	Hourly		45.6	200	22.8
1D	Annual	µg/m3	0.3	40	0.79
	Hourly		45.6	200	22.8
2A	Annual	µg/m3	0.2	40	0.48
	Hourly		44.7	200	22.3
2B	Annual	µg/m3	0.2	40	0.48
	Hourly		44.7	200	22.3
2C	Annual	µg/m3	0.2	40	0.48
	Hourly		44.7	200	22.3
2D	Annual	µg/m3	0.2	40	0.48
	Hourly		44.7	200	22.3
3A	Annual	µg/m3	0.2	40	0.54
	Hourly		14.7	200	7.3

The predicted PC is potentially significant, but below the assessment level. The predicted environmental concentrations (taking into account the baseline concentrations) are shown in the following Tables 11.8.2 and 11.8.3 for 2021 and 2031 respectively.

Table 11.8.2 Total NO_2 predicted environmental concentration in 2021

Receptor	Averaging	Baseline (µg/m3)	PEC	EAL	%EAL
22	Annual	17.3	17.7	40	44.2
	Hourly	34.7	79.7	200	39.9
23	Annual	17.1	17.5	40	43.7
	Hourly	34.1	79.2	200	39.6
24	Annual	16.0	16.4	40	40.9
	Hourly	31.9	77.0	200	38.5
25	Annual	18.4	18.8	40	47.1
	Hourly	36.7	72.7	200	36.4
26	Annual	18.4	19.0	40	47.5
	Hourly	36.8	73.0	200	36.5
27	Annual	17.9	18.6	40	46.4
	Hourly	35.9	73.1	200	36.5
28	Annual	13.8	14.4	40	36.0
	Hourly	27.6	47.8	200	23.9
29	Annual	13.2	13.4	40	33.4
	Hourly	26.4	39.5	200	19.7
1A	Annual	12.4	12.7	40	31.8
	Hourly	24.8	70.3	200	35.2
1B	Annual	12.4	12.7	40	31.8
	Hourly	24.8	70.3	200	35.2
1C	Annual	12.4	12.7	40	31.8

Receptor	Averaging	Baseline (µg/m3)	PEC	EAL	%EAL
	Hourly	24.8	70.3	200	35.2
1D	Annual	12.4	12.7	40	31.7
	Hourly	24.8	70.3	200	35.2
2A	Annual	12.3	12.5	40	31.2
	Hourly	24.6	69.3	200	34.6
2B	Annual	12.3	12.5	40	31.2
	Hourly	24.6	69.3	200	34.6
2C	Annual	12.3	12.5	40	31.2
	Hourly	24.6	69.3	200	34.6
2D	Annual	12.3	12.5	40	31.2
	Hourly	24.6	69.3	200	34.6
3A	Annual	12.4	12.7	40	31.7
	Hourly	24.9	39.5	200	19.8

Table 11.8.3 Total NO_2 Predicted Environmental Concentration in 2031

Receptor	Averaging	Baseline (µg/m3)	PEC	EAL	%EAL
22	Annual	12.6	12.9	40	32.3
	Hourly	25.2	70.3	200	35.2
23	Annual	12.4	12.9	40	32.1
	Hourly	24.9	70.0	200	35.0
24	Annual	11.8	12.2	40	30.5
	Hourly	23.5	68.6	200	34.3
25	Annual	13.2	13.7	40	34.3
	Hourly	26.5	62.5	200	31.2
26	Annual	13.3	13.9	40	34.6
	Hourly	26.5	62.8	200	31.4
27	Annual	13.0	13.6	40	34.0
	Hourly	25.9	63.1	200	31.6
28	Annual	10.2	10.8	40	26.9
	Hourly	20.4	40.5	200	20.3
29	Annual	10.0	10.2	40	25.5
	Hourly	20.0	33.1	200	16.5
1A	Annual	9.6	9.9	40	24.7
	Hourly	19.1	64.7	200	32.3
1B	Annual	9.5	9.9	40	24.6
	Hourly	19.1	64.6	200	32.3
1C	Annual	9.5	9.9	40	24.6
	Hourly	19.1	64.6	200	32.3
1D	Annual	9.5	9.9	40	24.6
	Hourly	19.1	64.6	200	32.3
2A	Annual	9.5	9.7	40	24.2
	Hourly	19.0	63.6	200	31.8
2B	Annual	9.5	9.7	40	24.2
	Hourly	19.0	63.6	200	31.8
2C	Annual	9.5	9.7	40	24.2
	Hourly	19.0	63.6	200	31.8
2D	Annual	9.5	9.7	40	24.2
	Hourly	19.0	63.6	200	31.8
3A	Annual	9.6	9.8	40	24.4
	Hourly	19.1	33.8	200	16.9

The maximum predicted environmental concentrations are well below the assessments levels. The combined effect of emissions from road traffic and the Energy Centre will not lead to a breach of national air quality strategy objectives.

Appendix 11.9 Road traffic emission factors

Introduction

Atmospheric dispersion modelling is used to determine the effect of future development traffic on local air quality. The modelling utilises predictions of the composition and emissions profile of the vehicle fleet which are produced by Defra in the emissions factor toolkit (EFT). The composition and emissions profiles are provided on a year by year basis from 2013 to 2030, with the database being periodically updated.

The main issue with regard to the modelling of future traffic impacts is the choice of emission factors to use given that there is a degree of uncertainty as to the accuracy of the emission factors, as well as uncertainty introduced by the modelling process and the traffic data on which the predictions are based. This has become more important in recent years as it has been realised that previous versions of the EFT were likely to have significantly underestimated the real world emissions of the vehicle fleet, as well as the more recent revelations concerning the use of 'defeat devices' on VW group vehicles.

This note therefore sets out PBAs approach to the choice of vehicle emission factors for future year assessments. The note has been revised following updating of the Defra Emissions Factor Toolkit in July 2016.

Modelling method

As a prelude to the discussion of emission factors, it is useful to recap on the general method that is used for dispersion modelling of road traffic emissions:

- Traffic data is entered into the dispersion model to represent the baseline situation and the model is used to predict how NO_x emissions are dispersed in the environment.
- The dispersion modelling predictions are compared to monitoring data to obtain a verification factor; the factor by which the predicted road traffic concentration must be multiplied by to agree with the monitored concentration.
- The modelling is repeated for the future year situation; with traffic data representing the situation without the development in place (the 'without' scheme scenario) and with the development in place ('with' scheme). In both cases, the verification factor obtained from the baseline modelling is used to multiply the model results by, in essence assuming that the model is equally as accurate in the future as it was for the baseline scenario.

The verification factor is one of the key elements in the discussion regarding vehicle emission factors. One element of uncertainty in the modelling is the degree to which the emission factors in the EFT are different to actual emissions of the vehicle fleet on the local road network. The use of the verification factor for the future year predictions essentially assumes that the difference between the EFT emission factors and real world emissions is the same in the future as it was in the baseline year. In other words, unless there is some reason to believe that the future year emission factors are less accurate than the baseline year emission factors, the degree to which the EFT emission factors and real world emission factors differ is taken into account in the modelling by the use of the verification factor. This is discussed further in the following sections.

Emission factor toolkit

The EFT contains estimates of the future composition of the vehicle fleet in terms of the age and type of vehicles. The composition of the vehicle fleet is primarily related to the age of the vehicles (in terms of their emissions class) and the fuel that they use (i.e. petrol or diesel). In general terms, the majority of new vehicles replace much older vehicles, and as the emissions performance of vehicles is generally taken to improve over time, both current and historical versions of the EFT predict very large reductions in NOx emissions in the future. It is also obvious that the further one looks into the future, the more uncertain the predictions become as they depend on the rate of vehicle renewal and the size and fuel mix of the vehicles bought; which are all estimates.

The emissions performance of the vehicles is classified in terms of Euro type approval testing; Euro 1 to 6 concerning light duty vehicles and Euro I to VI heavy duty vehicles. Whilst the introduction of each Euro class has generally seen a tightening of emission standards, the standards up until now have been based on laboratory testing of vehicles. The emissions performance of the vehicles in real world driving conditions has been higher than the laboratory testing results, especially for diesel vehicles. This factor was not recognised in earlier versions of the EFT, and combined with the fact that diesel vehicles have much higher NOx emissions than petrol vehicles and there has been a very large increase in the number of diesel vehicles on the road, has meant that the NOx emissions and NO2 concentrations have not reduced as previously predicted.

The trends in NOx emissions in the vehicle fleet, especially diesel vehicles and the accuracy of the current version of the EFT, is therefore critical in terms of the choice of emission factors in modelling.

Trends in NO_x emissions

For light duty vehicles, the latest Euro standard is Euro 6, which was introduced from September 2015 (with a derogation in the UK for the registration of new vehicles until September 2016).

The emissions standards currently relate to a laboratory test whereby the average emission rate is calculated over an idealised drive cycle. The cycle used is the New European Drive Cycle (NEDC) and there has been extensive criticism that the drive cycle does not represent real world driving conditions. It has therefore been agreed that a new drive cycle will be introduced, the World Light-duty Test Cycle (WLDTC), as well as an on-road test termed Real Driving Emissions (RDE).

Current Euro 6 vehicles are only tested in the laboratory against the NEDC, and these vehicles are termed Euro 6ab. However, from September 2017, new models will be tested against the WLDTC and will also have a RDE test. The initial introduction of the RDE test will allow vehicles to have average RDE test emissions of 2.1 times the WLDTC test; in other words, real life emissions will be allowed to be 2.1 times the laboratory emissions. The 2.1 factor is termed the conformity factor and will apply to new models from September 2017 and new vehicles from September 2019. From January 2020, the conformity factor will reduce to 1.5 for new models (January 2021 for new vehicles).

Air Quality Consultants have undertaken some research into the performance of diesel vehicles to support a method that they have adopted for undertaking air quality assessments1. As part of the analysis, they compared the real word test results of current Euro 6ab diesel vehicles and calculated an average conformity factor of 3.9 from the tests that were assessed.

[1] Emissions of Nitrogen Oxides from Modern Diesel Vehicles. AQC January 2016

Subsequently, Department for Transport have undertaken testing of Euro 5 and 6ab diesel vehicles and found that the average NOx emissions were 1135 mg/km for Euro 5 vehicles and 500 mg/km for Euro 6ab vehicles2. These work out to be a conformity factor of 6.30 and 6.25 for Euro 5 and Euro 6ab respectively. Adding in the DfTr results to the AQC results gives an overall average conformity factor for Euro 6ab vehicles tested of 4.1.

A paper presented by Dr Marc Stettler at the recent Westminster Energy, Environment & Transport Forum3 included results of RDE testing of existing Euro 6ab vehicles. Whilst there was wide range in the results, a number of the vehicles tested did already comply with the Euro 6c standard.

From the emissions testing work undertaken to date on Euro 6ab vehicles it is clear that the NOx emissions performance of Euro 6ab vehicles is significantly better than Euro 5 vehicles, although not in line with the laboratory standards. The introduction of Euro 6 should therefore see a significant reduction in NOx emissions in the future, as outlined in Table 11.10.1.

Table 11.9.1 Comparison of emissions

Emission Standard	Real Driving Emissions NOx mg/km
Euro 5, DfTr testing	1135
Euro 6ab, DfTr testing	500
Euro 6c, September 2017 models	168
Euro 6c, January 2020 models	120

In terms of modelling, the issue therefore becomes how well does the EFT represent the real world emissions performance of the vehicles.

Emissions in the EFT

As noted in Section 3, the EFT contains estimates of vehicle emissions by Euro Class. The database has recently been updated in July 2016 from v6.02 to v7.0. It now uses NOx emissions factors for the vehicles taken from the European Environment Agency's COPERT 4 V11 database compared to the previous version V10. In the latest submissions to the European Union for compliance against EU Limit Values, Defra used COPERT 4 V11 factors. The latest emission factors are lower than those in the previous version of the EFT.

The AQC paper provides a representation of the emissions from Euro 6 vehicles at different speeds in terms of the conformity factor. The results are shown in the following graph.

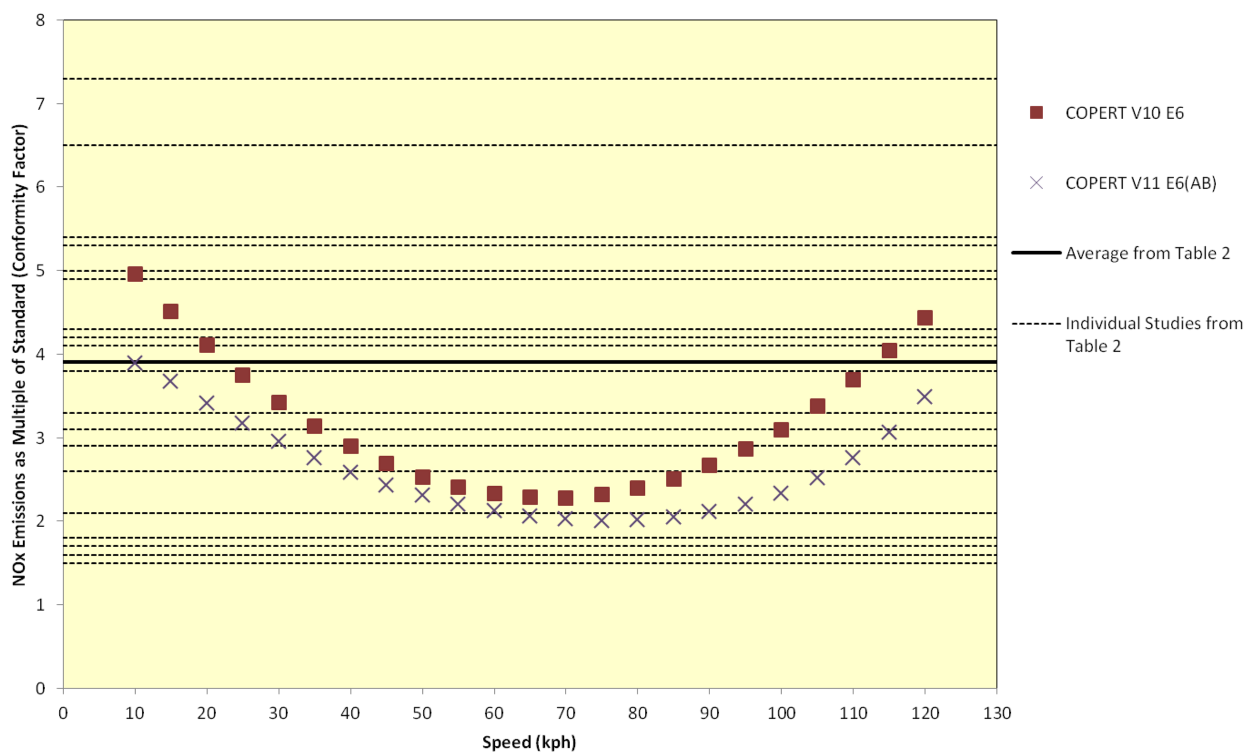

Figure 11.9.1 Emissions from Euro 6 vehicles at different speeds in terms of the conformity factor

The graph shows that the EFT emissions have a conformity factor ranging from 2.3 to 5. The conformity factor is higher at low and high speeds. Overall, the average conformity factor is less than the factor determined from the testing of Euro 6ab vehicles to date, but higher than the conformity factor that will be required by the introduction of Euro 6c. The COPERT v11 factors for Euro 6ab vehicles would appear to be, on average, approximately 80% of the V10 factors.

In terms of light duty vehicles, the AQC report concluded that for future year assessments, the base case modelling should use the EFT v6.02 factors for the future year of the traffic data, i.e. unaltered. However, a sensitivity test was also recommended, whereby the average conformity factor for Euro 6 diesel vehicles is raised to 5, with the following result in terms of the EFT.

2 Vehicle Emissions Testing Programme DfTr Cm 9259 April 2016

3 Priorities for reducing air quality impacts of road vehicles. Dr Marc Stettler 17th May 2016

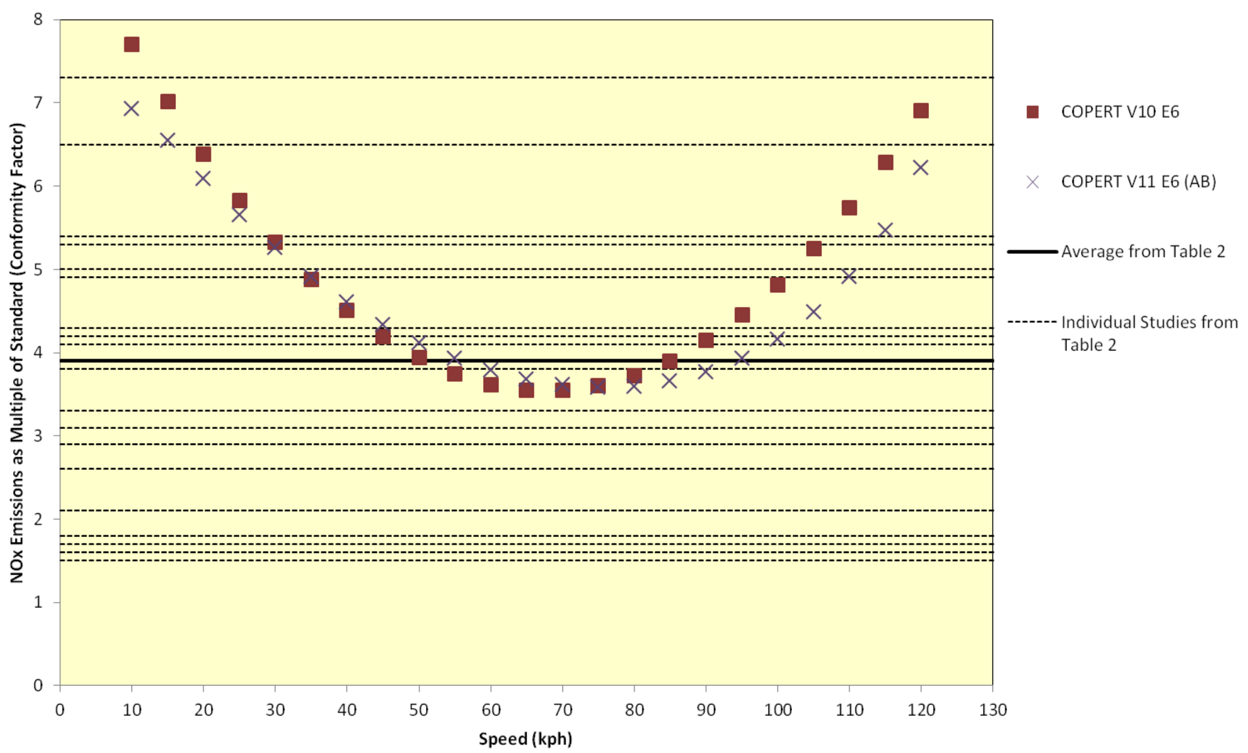

Figure 11.9.1 Sensitivity test results

Clearly, using the sensitivity test, the average emission rate in the EFT is higher than the average from the Euro 6ab testing to date, for either COPERT v10 or v11 factors. The AQC report concluded that if the two assessments were undertaken, then the likely pollutant concentration would lie between the two estimates.

However, the AQC report also acknowledges that the EFT does not include Euro 6c vehicles which should have significantly lower NO_x emissions than current Euro 6ab vehicles, and therefore both sets of results could be conservative.

Clearly, using the sensitivity test, the average emission rate in the EFT is higher than the average from the Euro 6ab testing to date, for either COPERT v10 or v11 factors. The AQC report concluded that if the two assessments were undertaken, then the likely pollutant concentration would lie between the two estimates.

However, the AQC report also acknowledges that the EFT does not include Euro 6c vehicles which should have significantly lower NO_x emissions than current Euro 6ab vehicles, and therefore both sets of results could be conservative.

Future year assessment method

The selection of emission factors for a future year assessment depends partly on the situation regarding the assessment to be undertaken. Where pollutant concentrations are low and are unlikely to exceed threshold levels, then one may take a conservative approach and keep emission factors at current levels. This will produce a conservative result, but as the result will be ‘acceptable’ in terms of leading to no exceedances of National Air Quality Strategy Objectives, then it is a reasonable approach to adopt as it avoids uncertainty as to whether there will be exceedances in the future.

In contrast, where pollutant concentrations are high, then a different approach to uncertainty is required. In addition, for a formal Environmental Impact Assessment the legal requirement is to assess ‘likely significant effects’. This is not ‘worst case’ significant effects, but ‘likely’ significant effects and therefore must allow for a degree of uncertainty in the predictions.

The approach taken to date by PBA for the assessment of future year effects when the development is completed a number of years into the future is to choose an intermediate year between the baseline model verification year and the completed development year. This approach requires revisiting in light of the latest information regarding vehicle emission factors.

As noted in Section 6, the AQC approach is to undertake two assessments; one using the EFT for the assessment year and one using higher emission factors for a sensitivity test. In addition to consideration of diesel car emissions, the AQC approach also considers taxis, light goods vehicles and heavy duty vehicles (HDVs). For taxis and light goods vehicles, a similar approach to diesel cars is proposed.

The evidence on the performance of Euro VI HDVs is more difficult to interpret; but it indicates significantly reduced NOx emissions between Euro V and VI, although the AQC report concludes that the EFT may underestimate emissions of Euro VI HDVs. The approach proposed by AQC for HDVs for COPERT v10 emissions is to keep Euro IV and Euro V emissions the same as Euro III and make Euro VI emissions 20% of Euro V. This approach was considered to result in slightly high HDV emissions. The average COPERT v11 HDV emission factors are higher than v10 at speeds above 40 kph and lower at speeds less than 40 kph (AQC, Figure 23). Overall therefore, it would appear to be appropriate to continue the proposed AQC approach for HDV emissions for COPERT v11 emission factors.

The following graph has been prepared using the AQC approach (CURED v2A) and the EFT v7 for urban vehicles outside of London at 30kph with a 5% heavy duty vehicles mix. Given that both emissions estimates would need to be verified against the same monitoring data, then the predictions would be the same for the same initial model verification year (i.e. 2015 in this case). The relative difference in the predicted emissions in the future is therefore the important factor.

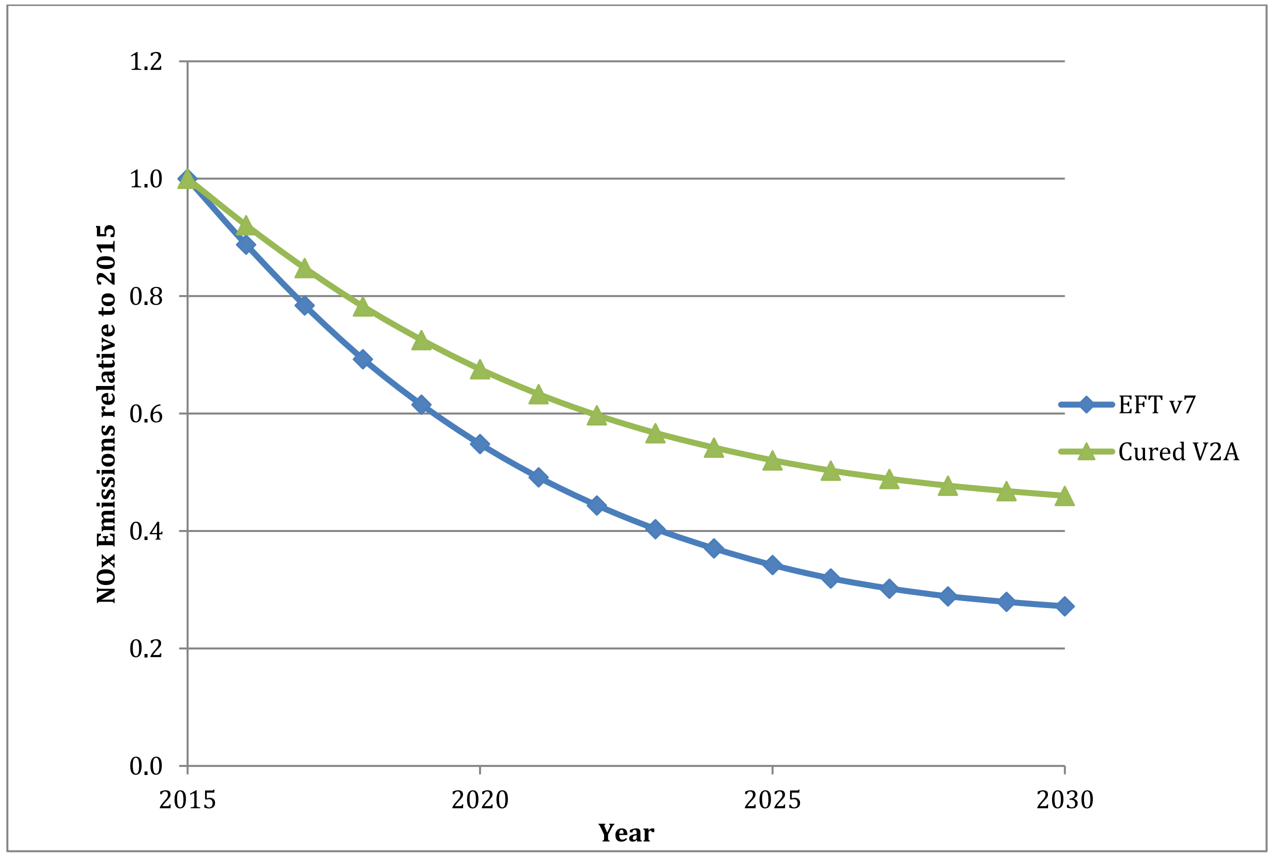

Figure 11.9.3 Comparison of AQC and EFT

Prior to 2020, the difference between the emission factors amounts to less than 2 years; it rises to approximately 9 years by 2030 as a greater proportion of Euro 6 vehicles is contained in the vehicle fleet and the AQC Cured emissions remain essentially at Euro 6ab levels.

As noted in Section 5, the EFT does not take account of the introduction of Euro 6c vehicles, which will begin to be introduced from 2017 with a conformity factor of 2.1, and from 2020 with a conformity factor of 1.5, significantly lower than the average for v7 of the EFT. Beyond 2020 therefore, as Euro 6c vehicles become more prominent in the vehicle fleet, the EFT is likely to become more representative of real world emissions than it currently is.

As discussed in Section 2, the use of the verification factor in the modelling takes account, amongst other things, of the difference in the real world emissions performance of vehicles in the fleet. Data contained within the AQC report indicates that the EFT may have underestimated emissions of earlier classes of vehicles to a similar extent as for Euro 6ab vehicles. As such, one could be justified in using the emission factors from the year of the assessment as the uncertainty in the emission factors is taken account of by using the verification factor.

The verification factor is not the only consideration however:

- The emission factors are in terms of NOx which is a combination of NO and NO2. Historically, most of the NOx emission was NO, with a small proportion of NO2. There is some evidence that the proportion of NO2 in the NOx is rising, which would counteract reductions in overall NOx emissions when one considers compliance with NO2 National Air Quality Strategy Objectives.
- There is uncertainty in the production of the traffic data on which the air quality modelling is based, as well as uncertainty within the EFT as it is based on assumptions regarding the replacement of vehicles into the vehicle fleet (over and above assumptions on the actual emissions performance of those vehicles).
- The predicted pollutant concentration from the road traffic modelling is added to an estimate of the background concentration, which itself, is subject to uncertainty.

The above factors justify a more conservative approach to future year emissions than simply using the EFT emission factors for the year of the assessment.

Taking into account the various factors discussed above, it is proposed that for the determination of likely significant effects we will use an emissions year two years earlier for future year assessments up until 2025, and three years earlier from 2026. This is likely to be conservative given the introduction of Euro 6c vehicles into the fleet (from 2017), but recognising increasing uncertainty regarding predicting the composition of the vehicle fleet and vehicle emissions in the future. Table 11.10.2 shows the effect of the proposals.

Table 11.9.2 Effect of the proposals

Assessment Year	Emission Factor Year
2015	2015
2016	2015
2017	2015
2018	2016
2019	2017
2020	2018
2021	2019
2022	2020
2023	2021
2024	2022
2025	2023
2026	2023
2027	2024
2028	2025
2029	2026
2030	2027
2031	2028
2032	2029
2033 and beyond	2030

The choice of emission factors and background concentrations needs to take into account the specific circumstances of the assessment being undertaken, but the above approach is considered to provide a conservative basis on which to assess likely future pollutant concentrations.

Appendix 12.4 Traffic data used for noise modelling

No.	Link / Notes Refer to Reference Link Plan	2021 DM		2021 DS		2031 DM		2031 DS	
		Observed / estimated Combined one-way 18hr Base 5d flows	Observed / estimated 18 hr 5d >3.5t %	Observed / estimated Combined one-way 18hr Base 5d flows	Observed / estimated 18 hr 5d >3.5t %	Observed / estimated Combined one-way 18hr Base 5d flows	Observed / estimated 18 hr 5d >3.5t %	Observed / estimated Combined one-way 18hr Base 5d flows	Observed / estimated 18 hr 5d >3.5t %
1.0	M11 - J12 - J13 - Nbd	46509	16%	46943	16%	48166	16%	49630	16%
1.0	M11 - J12 - J13 - Sbd	46924	16%	47072	16%	49057	16%	50066	16%
1.1	M11 J13 -J14 - Nbd	33816	16%	33589	16%	34806	16%	34511	16%
1.1	M11 J13 -J14 - Sbd	33370	16%	33154	16%	34620	16%	34272	16%
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Nbd	24053	16%	23865	16%	24961	16%	24709	16%
1.2	M11 between A14 Ebd on-slip / Huntingdon Rd on slip - Sbd	24488	16%	24306	16%	25561	16%	25284	16%
1.3	M11 J13 off-slip - Nbd	11359	16%	12012	16%	12013	16%	13778	16%
1.3	M11 J13 on-slip - Sbd	8883	16%	9252	16%	9765	16%	11129	16%
3.0	A1303 East of Madingley Mulch R'bout Ebd	7695	6%	7930	6%	8563	6%	9253	6%
3.0	A1303 East of Madingley Mulch R'bout Wbd	12705	6%	12851	6%	13523	6%	14046	6%
3.1	Madingley Rd - East of Cambridge Rd Crossroads Wbd	11789	6%	11945	6%	12607	6%	13195	6%
3.1	Madingley Rd - East of Cambridge Rd Crossroads Ebd	8694	6%	8958	6%	9568	6%	10340	6%
3.2	Madingley Rd on Over Bridge M11 Ebd	12599	6%	13614	6%	13889	6%	16669	6%
3.2	Madingley Rd on Over Bridge M11 Wbd	6033	6%	6234	6%	6553	6%	7225	6%
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Ebd	11266	4%	12242	4%	12091	4%	14738	4%
3.3	Madingley Rd between M11 Sbd On Slip - Proposed Madingley Rd West Access Wbd	10707	4%	11294	4%	11704	4%	13780	4%
3.4	Madingley Rd - West of P&R Access Wbd	10707	4%	11818	4%	11704	4%	10181	4%
3.4	Madingley Rd - West of P&R Access Ebd	11266	4%	12580	4%	12091	4%	10942	4%
3.5	Madingley Rd - East of P&R Access Wbd	9787	4%	10765	4%	10783	4%	9127	4%
3.5	Madingley Rd - East of P&R Access Ebd	10650	4%	12091	4%	11475	4%	10454	4%
3.6	Madingley Rd - East of Proposed High Cross Access Ebd	9363	4%	11812	4%	10036	4%	12478	4%
3.6	Madingley Rd - East of Proposed High Cross Access Wbd	8548	4%	10352	4%	9360	4%	11437	4%
3.7	Madingley Rd - East of JJ Thomson Ave Ebd	10352	4%	11380	4%	11038	4%	13494	4%
3.7	Madingley Rd - East of JJ Thomson Ave Wbd	9052	4%	10066	4%	9661	4%	12631	4%
3.8	Madingley Rd - East of Clerk Maxwell Rd Ebd	10158	4%	11521	4%	10843	4%	14031	4%
3.8	Madingley Rd - East of Clerk Maxwell Rd Wbd	9011	4%	10794	4%	9621	4%	13610	4%
12.0	Western Access to Madingley Rd Nbd	0	7%	0	7%	0	7%	3144	7%
12.0	Western Access to Madingley Rd Sbd	0	7%	0	7%	0	7%	3177	7%
12.1	High Cross Access to Madingley Rd Nbd	1031	7%	3426	7%	1031	7%	3379	7%
12.1	High Cross Access to Madingley Rd Sbd	1240	7%	3614	7%	1240	7%	4145	7%
12.2	JJ Thomson Ave Access to Madingley Rd Nbd	1740	7%	1457	7%	1740	7%	2885	7%
12.2	JJ Thomson Ave Access to Madingley Rd Sbd	1329	7%	1588	7%	1329	7%	3083	7%
12.3	Clerk Maxwell Rd Nbd - south of Car Park Access	199	7%	65	7%	199	7%	65	7%
12.3	Clerk Maxwell Rd Sbd - south of Car Park Access	194	7%	62	7%	194	7%	62	7%
12.4	Clerk Maxwell Rd Sbd - north of Car Park Access	498	7%	1002	7%	498	7%	1036	7%
12.4	Clerk Maxwell Rd Nbd - north of Car Park Access	508	7%	1021	7%	508	7%	1056	7%

Appendix 12.5 Ramboll noise survey for the Cavendish III Laboratories 2016

Intended for
Jestico & Whiles

Document reference
R01/rev.01

Date
06 April 2016

UNIVERSITY OF CAMBRIDGE DEPARTMENT OF PHYSICS CAVENDISH III PROJECT

NOISE SURVEY REPORT

(INCLUDING ADDITIONAL MEASUREMENTS)

RAMBOLL ENVIRON

CAVENDISH III PROJECT
(INCLUDING ADDITIONAL MEASUREMENTS)

Revision	**01**
Date	**06/04/2016**
Made by	**Emilie Carayol**
Checked by	**Raf Orlowski**
Approved by	**Raf Orlowski**
Description	**Noise survey report**
Job number	**1620001378**

Rev no.	Date	Document Ref.	Comments
01	06/04/2016	R01/rev 01 – Noise Survey Report	Additional measurements carried out to define zone where natural ventilation is possible
-	30/03/2016	R01– Noise Survey Report	

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CONTENTS

FIGURES

APPENDICES

1. INTRODUCTION

A baseline noise survey has been carried out at the site of the proposed new building for the Department of Physics Cavendish III project at the University of Cambridge.

External noise measurements were made continuously from Friday 26th February 2016 until Friday 4th March 2016.

The survey was conducted to ascertain the external noise levels at the facades of the proposed new building. The results of the survey will be used to inform the design of the building envelope to provide the required internal ambient noise levels in the new building.

Additional measurements were carried out on 5th April 2016 to define more precisely the zone where natural ventilation is possible.

It is anticipated that noise emission limits from the new building will be required by planning conditions. The results of this survey present the background noise levels at the northern and southern site boundaries, and may be used to set noise emission limits at these locations.

2. SITE DESCRIPTION

The site of the proposed new building is bound by the A1303 (Madingley Rd) to the North, a field to the South (intended to be the site of the proposed Shared Hub facilities), JJ Thomson Avenue to the East and an access road to the Department of Veterinary Medicine to the West. The site boundary is indicated in red in Figure 1.

The site currently consists of several fields with an access road running East to West between them.

2.1 Noise climate

The noise climate around the site is dominated by road traffic noise from Madingley Road. Other significant noise sources were vehicles on JJ Thomson Avenue, the access road to the Department of Veterinary Medicine, nearby construction and distant traffic on the M11.

3. SURVEY METHODOLOGY

Noise loggers were used to measure continuously at the North and South of the site from Friday 26th February to Friday 4th March 2016.

In addition, manned noise measurements were conducted between 16:00 and 17:30 on Friday 26 February 2016, and 08:00 and 11:00, and 16:00 and 18:30 on Thursday 3 March 2016 by Emilie Carayol and George Xanthoulis of Ramboll Acoustics.

Noise measurements were taken at approximately 1.2 metres above ground level and at a distance of at least 3 metres from the façade of any buildings and are considered representative of free-field measurements. The measurement duration was 15 minutes on 26 February and 10 minutes on 3 March. These measurement durations are considered representative of the reasonably consistent ambient noise climate at these locations.

The sound level meter calibration was checked immediately before and after the measurement periods. No significant drift in calibration was detected.

3.1 Weather

During the measurement periods on 26 February and 3 March, weather conditions were noted as dry and there was no significant wind at ground level.

3.2 Measurement locations

Figure 1 shows the measurement locations. The site boundary is indicated in red. ST1-4 are considered representative of the position of the corners of the proposed new building. LT1 and LT2 are considered representative of the northern and southern façades.

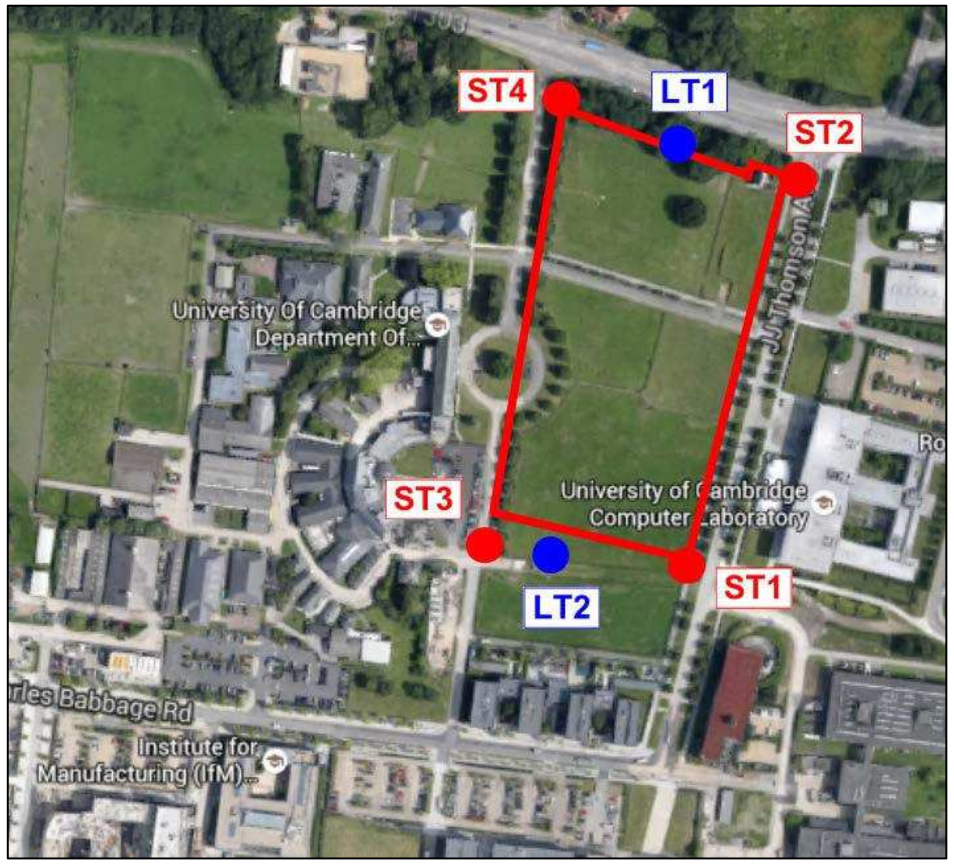


Figure 1 Site plan showing noise survey measurement locations

The locations are described as follows:

ST1: SE corner of the site, adjacent to JJ Thompson Avenue
ST2: NE corner of the site close to the junction of JJ Thomson Avenue and Madingley Rd
ST3: Representative of the SW corner of the site, adjacent to the access road for the Department of Veterinary Medicine
ST4: NW corner of the site, at the junction of the access road and Madingley Rd
LT1: North boundary between ST2 and ST4. 50m from eastern site boundary.
LT2: South boundary between ST1 and ST3. 70m from eastern site boundary.

3.3 Additional measurements

Five-minute measurements were undertaken on 5th April 2016 in the morning by Emilie Carayol to assess the noise level variations across the south half of the site.

The locations are represented on Figure 3 along with the noise results in Table 1.

The weather was noted as dry and there was no significant wind at ground level.

3.4 Equipment

The following measurement equipment was used to conduct the survey:

- Brüel and Kjær 2270 'Class 1' Sound Level Analyser
- Brüel and Kjær 4189 'Class 1' Pre-polarised ½" microphone
- Norsonic 118 'Class 1' Sound Level Analysers
- GRAS 40AS 'Class 1' Pre-polarised ½" microphones

All measurement equipment owned or hired and operated by Ramboll Acoustics has annual calibration checks carried out by external companies traceable to national standards. Copies of all calibration records are kept and can be provided upon request.

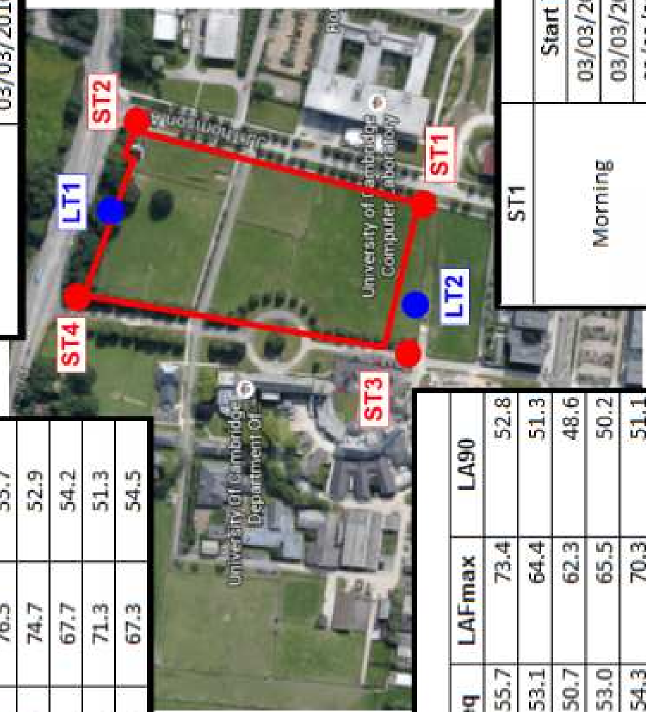
4. SURVEY RESULTS

A summary of the noise survey results at each manned measurement location is shown on a site plan in Figure 2. A sample of results for these locations and time history graphs for LT1 and LT2 are presented in Appendix A. The full set of data is available on request.

The results in Figure 2 show that higher sound levels were measured at the northern boundary of the site compared with the southern boundary of the site. The highest sound levels were measured at the North East corner of the site (ST2) and the lowest sound levels were measured at the South West corner of the site (ST3).

The time history graphs in Appendix 1 show the pattern of sound levels at the noise logger locations. For both noise loggers, the sound levels were lower during the night-time than the daytime, but there was a higher difference between the day and night-time levels for the north, where a sharp increase in level during the morning rush hour period was shown, due to traffic on Madingley Road.

During the daytime, the levels were fairly consistent and the levels reduced in the afternoon to evening period. The quietest period was around 01:00 – 03:00. At the north location, the larger difference between the background noise (L_{A90}) and average sound level (L_{Aeq}), is due to shorter term events from traffic noise. The L_{A90} and L_{Aeq} values at the south noise logger are closer in value, as this position is less affected by the traffic noise.



ST2	Start Time	LAeq	LAFmax	LA90
Morning	03/03/2016 08:28	62.7	74.5	54.5
	03/03/2016 09:23	62.1	74.4	54.7
	03/03/2016 10:21	61.2	74.8	51.4
Afternoon	03/03/2016 16:14	62.1	73.3	53.5
	03/03/2016 17:10	61.5	73.8	51.3
	03/03/2016 18:05	62.0	74.0	53.8

ST1	Start Time	LAeq	LAFmax	LA90
Morning	03/03/2016 08:14	59.5	73.3	55.8
	03/03/2016 09:08	59.4	71.1	55.2
	03/03/2016 10:06	57.9	70.2	53.4
Afternoon	03/03/2016 16:57	57.7	70.3	50.0
	03/03/2016 17:50	59.4	71.6	51.7
	03/03/2016 18:45	56.3	71.5	50.6
Afternoon	26/02/2016 16:19	56.3	74.8	46.1
	26/02/2016 16:54	56.5	77.2	46.0

ST4	Start Time	LAeq	LAFmax	LA90
Morning	03/03/2016 08:51	60.2	67.0	56.9
	03/03/2016 09:37	60.6	76.5	55.7
	03/03/2016 10:39	59.0	74.7	52.9
Afternoon	03/03/2016 16:29	60.1	67.7	54.2
	03/03/2016 17:23	56.4	71.3	51.3
	03/03/2016 18:18	59.6	67.3	54.5

ST3	Start Time	LAeq	LAFmax	LA90
Morning	03/03/2016 08:54	55.7	73.4	52.8
	03/03/2016 09:51	53.1	64.4	51.3
	03/03/2016 10:53	50.7	62.3	48.6
Afternoon	03/03/2016 16:43	53.0	65.5	50.2
	03/03/2016 17:37	54.3	70.3	51.1
	03/03/2016 18:31	53.7	63.2	52.2
Afternoon	26/02/2016 16:37	51.0	70.3	46.3
	26/02/2016 17:12	54.3	88.7	44.8

Figure 2 Summary of noise survey results at each measurement location (L_{Aeq} is ambient noise level and L_{A90} is background noise level)

The additional measurements, whose locations are shown in Figure 3, indicate that the levels in the south west quarter were below 50 dB and those in the south east quarter were below 55dB. The results are presented in Table 1.

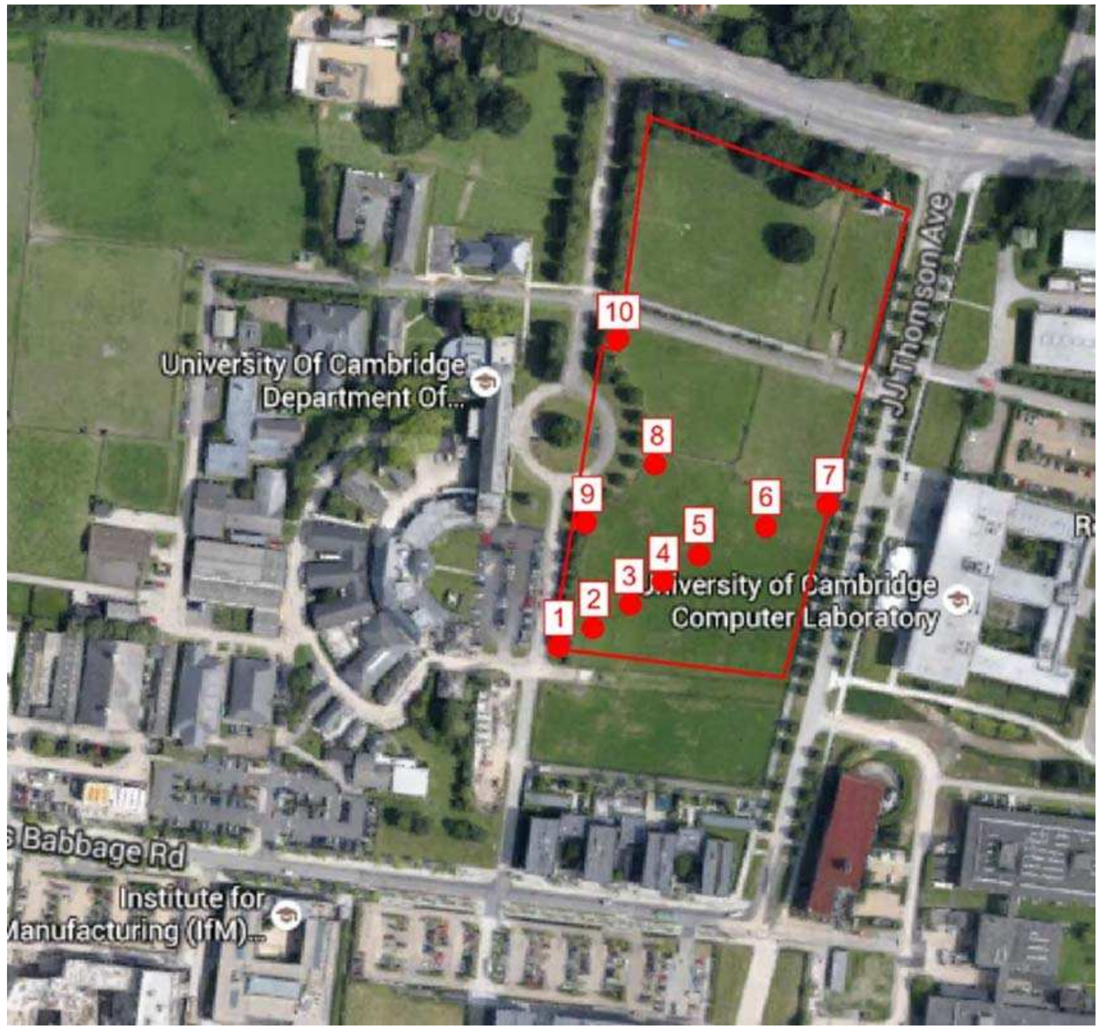


Figure 3 Additional noise monitoring locations at the south part of the site

Location	Time hh :mm	Ambient Noise Level $dBL_{Aeq, 5min}$	Background Noise Level $dBL_{A90, 5min}$
1	08 :44	50	49
2	09 :08	47	46
3	09 :20	49	48
4	09 :31	48	46
5	09 :38	50	48
6	09 :52	51	50
7	09 :57	55	49
8	10 :04	50	48
9	10 :10	48	45
10	10 :17	48	46

Table 1 Additional noise results at different locations across the south part of the site

This assessment has defined the areas where natural ventilation is suitable for rooms requiring an internal ambient noise level of 35 dBL_{Aeq} (private offices) and 40 dBL_{Aeq} (meeting/lecture rooms). These areas are respectively coloured in blue and yellow in Figure 4.

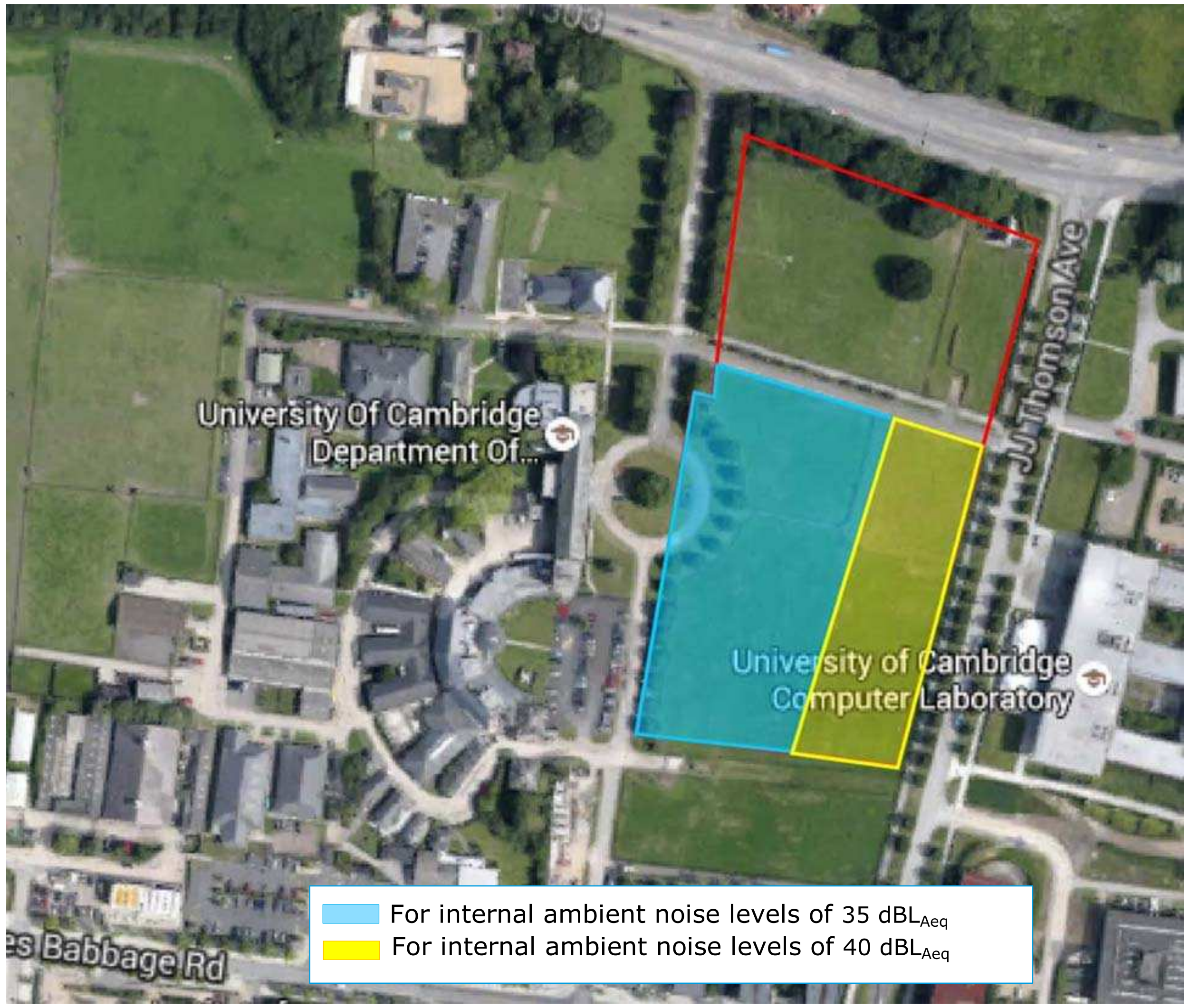


Figure 4 Natural ventilation area for internal ambient noise level of 35 dBL_{Aeq} and 40 dBL_{Aeq}

5. DESIGN IMPLICATIONS

5.1 Sound insulation of the building envelope

The manned measurements taken during the daytime ranged from 51 dB L_{Aeq} at the South of the site (ST3) to 63 dB L_{Aeq} at the North of the site (ST2).

Based on guidance given in BS 8233:2014, the appropriate criterion for indoor ambient noise levels in private offices is 35 dBL_{Aeq} and is 40 dB L_{Aeq} in meeting/lecture rooms. In the case of the laboratories; the ambient noise criterion will vary depending on the use of the laboratory.

The noise survey has indicated that the south of the site is significantly quieter than the north of the site which implies that the most noise sensitive spaces should be located in the southern section. Detailed design implications for north and south sections are discussed below.

5.1.1 North section of site

The least noise-sensitive spaces should be located in the north section of the site. Natural ventilation will be difficult to achieve in this section for offices and similar rooms. With mechanical ventilation, standard thermal double glazing will be sufficient providing a sound reduction of R_w 30 dB. The building fabric should provide sound reduction of at least 35 dB which is achievable with most building envelope materials.

5.1.2 South section of site – zone suitable for natural ventilation

Noise sensitive spaces can be located in the south section with the South West section being the quietest. Private offices and similar spaces which require an internal noise criterion of 35 dBL_{Aeq} can be naturally ventilated if located in the south west part of the site as represented in Figure 4. Meeting rooms and lecture rooms with a noise criterion of 40 dBL_{Aeq} can be located in the yellow area as described in Figure 4. For laboratories which are particularly noise sensitive or generate particularly high noise levels, fixed windows will need to be used with mechanical ventilation.

5.2 Noise emission limits

Measurement positions LT1 and LT2 are considered representative of the existing noise climate at the northern and southern site boundaries respectively. At LT1, the lowest measured background noise level (L_{A90}) in the daytime was 39 dB and at night-time was 34 dB. At LT2, the lowest measured background noise level in the daytime was 41 dB and at night-time was 39 dB.

These values can be used to set plant noise emission limits for any plant associated with the proposed new building at the site boundary which are likely to be subject to planning requirements.

For building services plant, noise emission will be controlled to meet the planning requirement using standard noise control measures, such as attenuators, enclosures or screens.

For specialised laboratory equipment which is installed externally, each installation will need to be assessed separately to apply appropriate noise control measures to meet the required condition. These measures could be in the form of enclosures, screens and barriers.

Where the specialised laboratory equipment is installed internally, the sound insulation of the laboratory in question may require higher performance double glazing and a higher sound insulating envelope.

This will be developed as the design progresses.

6. CONCLUSION

The results of the baseline noise survey are considered to be suitable to inform the design of the building envelope of the proposed new building to ensure that the internal ambient noise level requirements are achieved. The southern boundary is significantly quieter than the northern boundary and two areas have been identified where natural ventilation is suitable:

- Private offices requiring an ambient noise level of 35 dBL_{Aeq} can be located on the south west of the site
- Meeting/ Lecture rooms with an internal ambient noise level of 40 dBL_{Aeq} can be located on the south east part of the site.

Background noise levels have been measured at the northern and southern site boundaries. The results of these measurements are considered suitable to set noise emission limits from any plant associated with the new building at these locations.

APPENDIX 1
NOISE SURVEY DATA

Location	Time, hh:mm	Duration, mm:ss	Sound pressure level in one-third octave bands (Leq)																				
			50	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1k**	**1.25k**	**1.6k**	**2k**	**2.5k**	**3.15k**	**4k**	**5k**
ST1	03/03/2016 08:14	00:10:00	62	62	58	55	54	52	52	51	48	48	49	50	53	53	50	49	47	44	42	38	35
ST2	03/03/2016 08:28	00:10:00	66	66	63	61	56	56	56	55	54	52	53	53	54	55	53	53	51	49	46	43	40
ST3	03/03/2016 08:54	00:10:00	59	59	55	53	52	50	46	45	43	43	44	47	48	48	48	47	38	34	36	38	35
ST4	03/03/2016 08:41	00:10:00	63	64	59	57	55	52	52	51	48	47	47	50	53	54	52	51	48	44	40	38	33

Table A1: One-third Octave Band Sound Pressure Level, L_{eq}

Location	Time, hh:mm	Duration, mm:ss	Sound pressure level in one-third octave bands (L90)																				
			50	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1k**	**1.25k**	**1.6k**	**2k**	**2.5k**	**3.15k**	**4k**	**5k**
ST1	03/03/2016 16:57	00:10:00	54	52	51	50	48	45	43	41	40	38	39	40	43	43	40	37	33	30	28	26	21
ST2	03/03/2016 17:10	00:10:00	58	57	54	52	50	48	47	46	45	43	44	45	47	47	44	43	40	37	34	30	26
ST3	03/03/2016 16:43	00:10:00	52	50	49	48	46	43	41	39	37	35	38	41	44	44	40	37	32	27	24	20	16
ST4	03/03/2016 17:23	00:10:00	58	56	53	50	48	46	45	43	40	37	37	40	43	45	42	40	37	33	30	26	22

Table A2: One-third Octave Band Sound Pressure Level, L_{90}

Location	Time, hh:mm	Duration, mm:ss	Sound pressure level in one-third octave bands (Lmax)																				
			50	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1k**	**1.25k**	**1.6k**	**2k**	**2.5k**	**3.15k**	**4k**	**5k**
ST1	03/03/2016 08:14	00:10:00	77	76	74	66	64	65	71	72	61	64	64	65	67	67	64	63	63	60	57	57	51
ST2	03/03/2016 08:28	00:10:00	81	84	80	84	72	73	71	70	71	67	70	66	67	70	66	65	64	63	61	57	57
ST3	03/03/2016 08:54	00:10:00	73	70	65	66	70	70	58	57	56	56	54	54	56	66	73	70	52	52	58	62	57
ST4	03/03/2016 08:41	00:10:00	81	76	71	72	67	68	64	63	60	59	57	59	59	61	59	62	57	56	52	53	53

Table A3: One-third Octave Band Sound Pressure Level, L_{max}

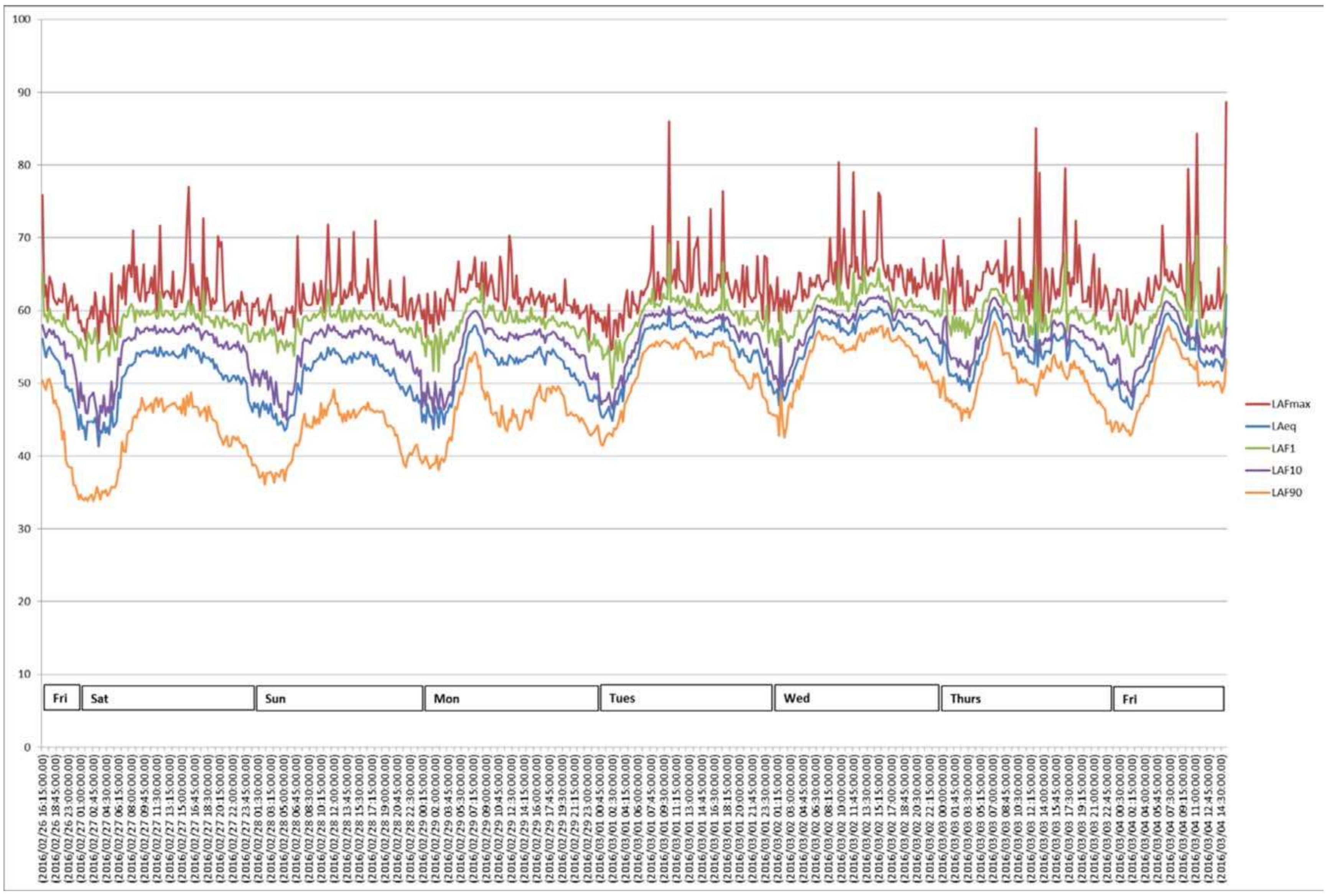


Figure 3 Time history for North logger

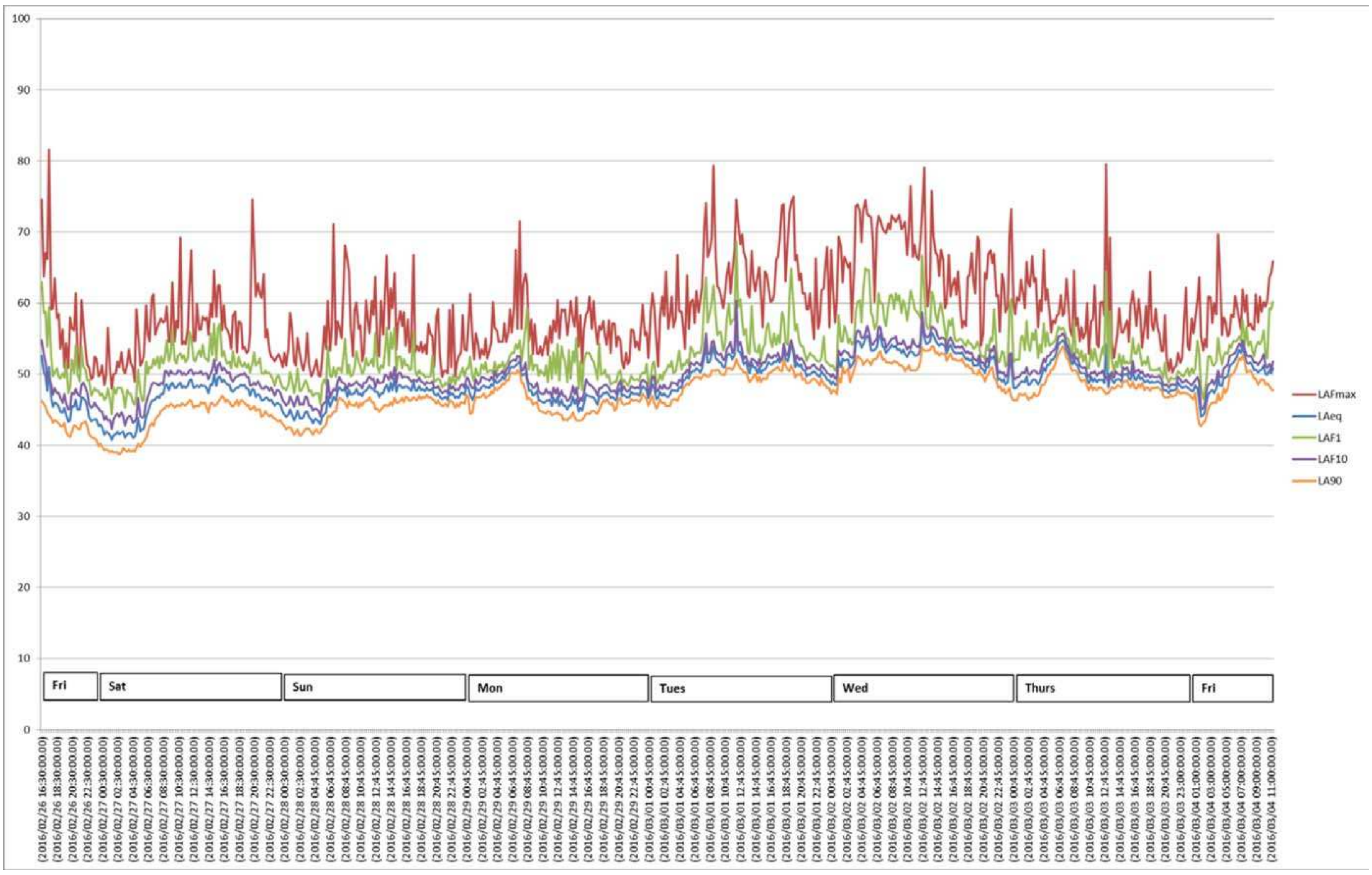


Figure 4 Time history for South logger

APPENDIX 2
ACOUSTIC TERMINOLOGY

A-WEIGHTED DECIBEL (dBA)

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.

EQUIVALENT CONTINUOUS SOUND LEVEL (L_{eq})

Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

MAXIMUM NOISE LEVEL (L_{max})

The maximum noise level identified during a measurement period. Experimental data has shown that the human ear does not generally register the full loudness of transient sound events of less than 125 ms in duration. Fast time weighting has an exponential time constant of 125 ms which reflects the ear's response. The maximum level measured with fast time weighting is denoted as $L_{AMax,f}$. Slow time weighting (S) with an exponential time constant of 1s is used to allow more accurate estimation of the average sound level on a visual display.

Impulse (I) time weighting has a fast rise (35ms) and a slow decay and is intended to mimic the ear's response to impulsive sounds.

SOUND REDUCTION INDEX (R)

The sound reduction index (or transmission loss) of a building element is a measure of the loss of sound through the material, i.e. its attenuation properties. It is a property of the component, unlike the sound level difference which is affected by the common area between the rooms and the acoustic of the receiving room. The weighted sound reduction index, R_w, is a single figure description of sound reduction index characterising a range of frequencies, which is defined in BS EN ISO 717-1: 1997. The R_w is calculated from measurements in an acoustic laboratory. Sound insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as the R'_w ratings.

STATISTICAL NOISE LEVELS

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for ten per cent of the time period under consideration, has historically been adopted in the UK for the assessment of road traffic noise. The L_{90}, the level exceeded for ninety per cent of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for one per cent of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted L_{A10},dB L_{A90} etc. The reference time period (T) is normally included, e.g. dB $L_{A10,\ 5min}$ or dB $L_{A90,\ 8hr}$.

TYPICAL NOISE LEVELS

Some typical noise levels are given in the following table.

Noise Level dB(A)	Example
130	Threshold of pain
120	Jet aircraft take-off at 100 m
110	Chain saw at 1 m
100	Inside disco
90	Heavy lorries at 5 m
80	Kerbside of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1m
40	Living room
30	Ventilation Noise in Theatre
20	Remote countryside on still night
10	Sound insulated test chamber
0	Threshold of hearing

Appendix 12.6 Max Fordham noise survey for the Civil Engineering Building 2016

UNIVERSITY OF CAMBRIDGE

Noise and Vibration Impact Assessment

Prepared by Max Fordham

Submitted as part of the planning application for the Civil Engineering Building

On the West Cambridge Site, Madingley Road, Cambridge

Version Rev F

Dated October 2016

The Civil Engineering Building

Noise & Vibration Impact Assessment

Rev F

October 2016

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ISSUE HISTORY

Issue	Date	Description
*	30/02/2016	For Information
A	13/07/2016	For Information
B	09/09/2016	For Information
C	28/09/2016	For Information
D	30/09/2016	For Information
E	30/09/2016	For Information
F	07/10/2016	For Planning Submission

MAX FORDHAM LLP TEAM CONTRIBUTORS

Engineer	Role
Peter Leonard	Project Acoustic Engineer
Anthony Chilton	Acoustic Team Leader
Josh Rodell	Graduate Acoustic Engineer

CONTENTS

1.0 INTRODUCTION

Max Fordham LLP have been appointed to provide acoustic design and advice for the new building on behalf of Grimshaw Architects.

An acoustic noise survey has been undertaken in order to establish the existing acoustic environment and baseline noise levels. A calculation of the airborne noise levels resulting from the proposed development has been prepared and an assessment of the significance of noise impact at the nearest noise sensitive receptors has been made. This report presents and summarises the results of this noise impact assessment.

Sound Space Vision, on behalf of Smith & Wallwork Ltd, have undertaken an assessment of the vibration impact from the proposed development and this vibration impact assessment is included in the appendices of this report.

2.0 RELEVANT STANDARDS AND GUIDANCE

2.1 National Planning Policy Framework

The NPPF sets out the Government's planning policies for England and how these are expected to be applied. Section 11 paragraph 123 of NPPF states that planning policies and decisions should aim to:

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

2.2 Noise Policy Statement for England

The Department for Environmental Food and Rural Affairs published the NPSE in 2010. This document is intended to apply to all forms of noise other than that which occurs in the workplace and includes environmental noise and neighbourhood noise in all forms.

The NPSE contains an explanatory notes which defines the NOEL, LOAEL and SOAEL terms which are used in the NPPF:

NOEL – No Observed Effect Level: This is the level below which no effect can be detected. In simple terms, below this level there is no detectable effect on health and quality of life due to the noise

LOAEL – Lowest Observed Adverse Effect Level: This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur

2.3 National Planning Practice Guidance

The NPPG published in 2014 states that "noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment".

The NPPG provides advice on how to determine the impact of noise, including whether or not a significant adverse effect "is occurring or likely to occur" and whether or not a "good standard of amenity can be achieved".

2.4 Local Noise Policy

Cambridge Environmental Health have confirmed that the noise impact requirements, relating to *'mechanical and electrical building services and other sound of an industrial and/or commercial nature, in order to protect the quality of life / amenity of neighbouring premises'* are as follows:

> *"To satisfy any plant noise assessment or noise insulation condition, the rating level (in accordance with BS4142:2014) from all plant, equipment and vents etc (collectively) associated with this*

application should be less than or equal to the existing background level (L90) at the boundary of the premises subject to this application and having regard to noise sensitive premises."

Policy 4/13 "Pollution and Amenity" of the Cambridge City Council's Local Plan (July, 2006) states:

"Development will only be permitted which:

a. does not lead to significant adverse effects on health, the environment and amenity from pollution; or

b. which can minimise any significant adverse effects through the use of appropriate reduction or mitigation measures.

Proposals that are sensitive to pollution, and located close to existing pollution sources, will be permitted only where adequate pollution mitigation measures are provided as part of the development package."

3.0 BACKGROUND NOISE SURVEY

Two long term noise surveys have been undertaken by Max Fordham LLP in order to establish the existing background noise levels at the site of the proposed building.

A 48-hour noise survey was undertaken from the 22nd – 24th February 2016, during a period where the roads are busy (few people on holiday). A second, 140-hour, noise survey was undertaken at the same location from the 26th August to 1st September 2016, during a school and university holidays when the traffic is much lighter. This survey period incorporates weekdays and weekends. There was a bank holiday Monday during this measurement period which for the purposes of this survey is assumed to be similar to a weekend day.

It is expected that noise levels during the weekend will be similar both within and outside of summer holiday periods.

The chosen measurement location is considered to be representative of the noise levels experienced at the nearest residential property to the proposed development, at The Lawns of Clerk Maxwell Road.

3.1 Survey Procedure

For both surveys a sound level meter was set up to make consecutive 15 minute noise throughout the survey duration.

The microphone of the sound level meter was mounted on a tripod externally, approximately 1.5m from the ground (See Figure 1 and Figure 2). This position is considered to be free-field and representative of noise levels experienced at the nearest noise sensitive properties to the proposed development. A weather protection kit was used. The sound level meter was calibrated at the beginning and end of the survey period and no significant drift was observed.

The weather conditions throughout the survey in February were moderately cold with wind speeds typically below 4m/s and no precipitation. During the survey in August the weather conditions were warm (typically between 15 and 25 degrees Celsius) with wind speeds typically below 5m/s. There were 2 short periods of rainfall (approx. 40 mins) during the survey at around 4pm and 9pm 28th August 2016.

All weather data is obtained from Atomwide Weather Station in Cambridge, approximately 1km from the measurement location.

A microphone windshield was used during all measurements. The weather conditions are not considered to have affected the noise survey results in any significant way during either survey.

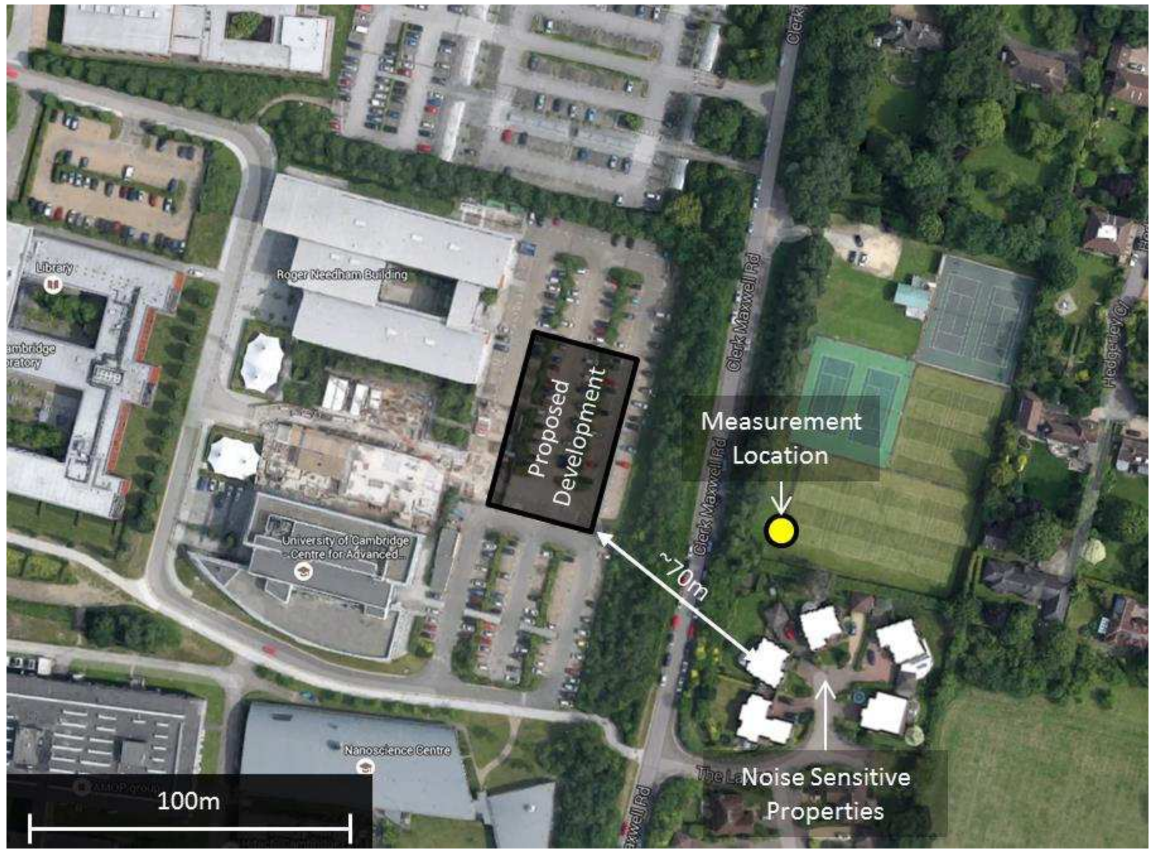


Figure 1 - Site Plan & Measurement Location

Figure 2 - Photo of 48-hour Survey

3.2 Survey Equipment

Table 1 and Table 2 below give details of the equipment used during the long term noise surveys and the dates are the relevant accredited calibration. Copies of calibration certificates are available upon request.

Item	Make	Type	Serial no.	Calibration Intervals	Last Calibrated	Next Due Calibration
Class 1 sound level meter	Norsonic	140	1405942	2 years	20/03/2014	20/03/2016
Microphone	Norsonic	1225	208215	2 years	20/03/2014	20/03/2016
Microphone preamplifier	Norsonic	1209	15804	2 years	20/03/2014	20/03/2016
Calibrator	Norsonic	1251	34059	1 year	11/04/2015	11/04/2016
A calibration check was undertaken using the sound pressure level calibrator producing 114.0 dB at an octave band centre frequency of 1000 Hz with reference to 2×10^{-5} N m^{-2} before and after the tests.						

Table 1 - 1st Survey Sound Level Meter and Calibrator Information

Item	Make	Type	Serial no.	Calibration Intervals	Last Calibrated	Next Due Calibration
Class 1 sound level meter	Norsonic	140	1405942	2 years	11/04/2016	11/04/2018
Microphone	Norsonic	1225	208215	2 years	11/04/2016	11/04/2018
Microphone preamplifier	Norsonic	1209	15804	2 years	11/04/2016	11/04/2018
Calibrator	Norsonic	1251	34059	1 year	11/04/2016	11/04/2017
A calibration check was undertaken using the sound pressure level calibrator producing 114.0 dB at an octave band centre frequency of 1000 Hz with reference to 2×10^{-5} N m^{-2} before and after the tests.						

Table 2 - 2nd Survey Sound Level Meter and Calibrator Information

3.3 Survey Results

The results of the noise surveys are presented graphically in Figure 3 and Figure 4 below. Table 3 gives a summary of the minimum background, "representative" background and logarithmic average values for day, evening and night time periods.

It is assumed that the differences in noise level between the two surveys is due to a reduced level of activity around in the local area during the second survey because it was during the summer holiday period. Values are separated further to show values for week days during busier seasons, week days outside busy seasons and weekends. In some respects the February survey results are likely to be more representative for the normal noise levels on site but to ensure acceptable noise levels the limits have been set on the more onerous survey.

BS4142:2014 states that the impact of noise should be assessed in comparison to the background noise level. However when obtaining the background noise level it is also noted that *"the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods".*

The proposed method of obtaining "typical" background noise levels is to discount the highest 20% of values in order to ensure outlying erroneous values are discounted then take the median of the remaining values to be representative of the background level. Therefore the 40th percentile value of background noise levels is used as a "representative" background noise level.

Histograms of the background noise level for each day, evening and night period are shown in Appendix A – Background Noise Level Histograms.

Parameter	Time Period	Busy Week	Holiday Week	Weekend
$L_{A90,15min}$ Minimum	Day (8am – 6pm)	42	38	37
	Eve (6pm - 11pm)	42	39	37
	Night (11pm – 8am)	40	36	31
$L_{A90,15min}$ 40th Percentile	Day (8am – 6pm)	47	42	42
	Eve (6pm - 11pm)	47	42	41
	Night (11pm – 8am)	43	40	37
$L_{Aeq,T}$	Day (8am – 6pm)	51	47	48
	Eve (6pm - 11pm)	49	46	46
	Night (11pm – 8am)	49	48	44

Table 3 - Summary of Noise Survey Results

In order to allow an assessment for particular time periods the representative background noise levels for Saturday mornings (9am to 1pm) have also been calculated as:

- Minimum $L_{A90,15min\ (9am – 1pm)}$ = 41dB
- 40th Percentile $L_{A90,15min\ (9am – 1pm)}$ = 42dB
- $L_{Aeq,(9am - 1pm)}$ = 47dB

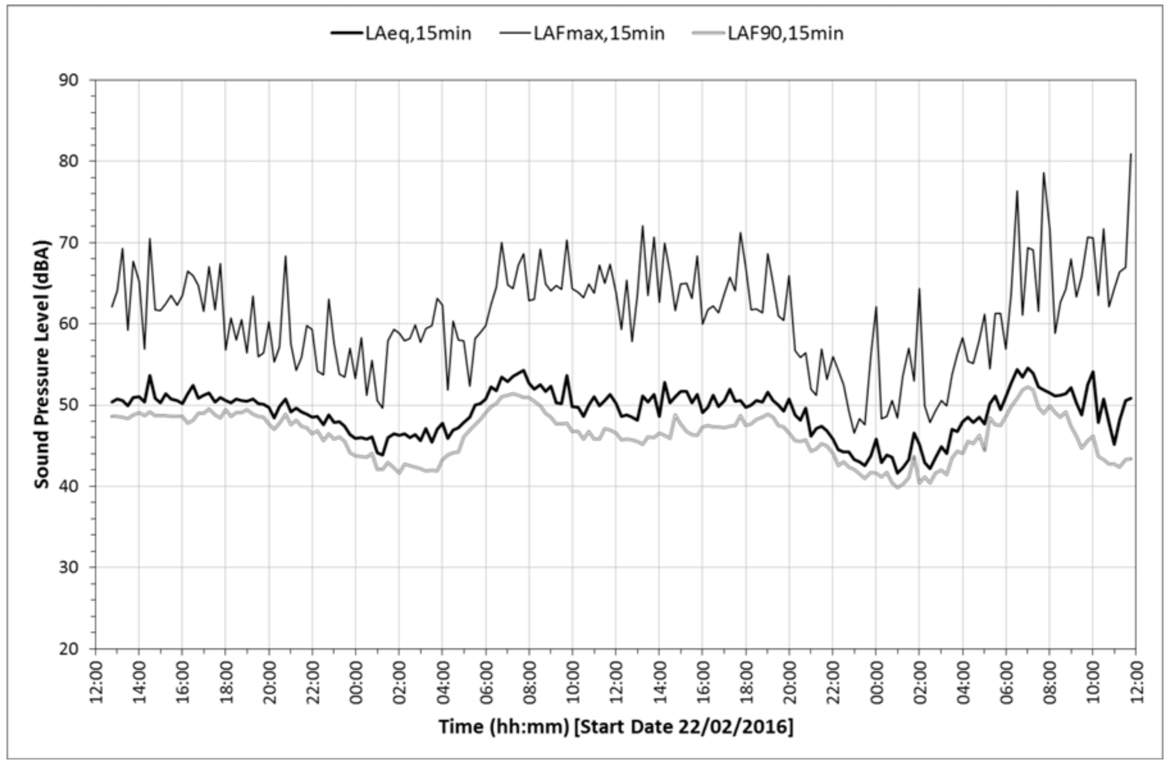


Figure 3- Summary of Survey Results (Feb Survey)

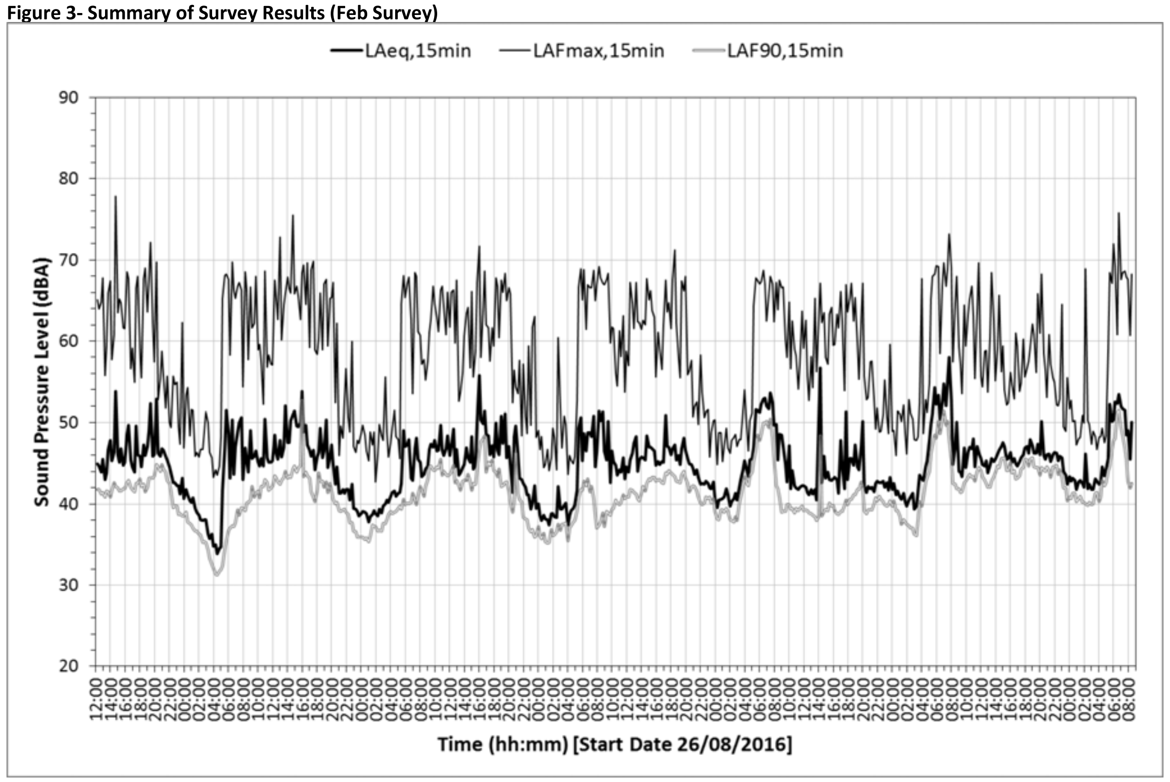


Figure 4 - Summary of Survey Results (Aug Survey)

4.0 TARGET NOISE LEVELS

There are two sources of noise which have been identified by the design team and Cambridge City Council as having a potential impact on nearby residents:

- Plant & Machinery Noise: Including both noise from fixed external plant and noise from machinery used within the structures lab.
- Delivery Access Road: Noise from vehicles on the access road, making deliveries to the structures lab.

4.1 Plant & Machinery

In order to avoid noise from the proposed site causing a noise impact on the nearby residential properties it is critical that noise from machinery and equipment is sufficiently attenuated. The usual method for rating and assessing industrial sound is set out in British Standard 4142:2014.

BS 4142 states that an estimate of the impact of the specific sound can be obtained by subtracting the background sound level from the rating level. The specific sound is the level of the new sound source (i.e. Concrete Mixer etc.) and the rating level is the specific sound level with penalties applied to account for certain characteristics of the sound.

It is then stated that:

- *A difference of around +10dB or more is likely to be an indication of a significant adverse impact.*
- *A difference of around +5dB is likely to be an indication of an adverse impact.*
- *Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.*

Cambridge Council have confirmed that an assessment should be made at the boundary of the proposed development and that the noise rating level should not exceed the background noise level as per the local authority noise policy described in Section 2.4.

4.2 Delivery Access Road

The delivery access road is a noise source which is associated with the development (rather than a public access road) and as such the local authority have requested that it should be assessed under the criteria of sound of an industrial/commercial nature as per BS 4142:2014

5.0 PLANT & MACHINERY NOISE LEVELS

5.1 Engineering Machinery Noise Levels

On 3rd February 2016 measurements were made of the equipment and machinery within the existing Cambridge University Engineering Department building on Trumpington Street, Cambridge.

The items of equipment measured were a concrete mixer, a concrete beam shaker and a jackhammer. See Figure 5 for photos of the items of machinery that were measured.

Figure 5 - Photos of Machinery

Measurements were taken at a distance far enough away from the item of machinery in order to ensure that the measurements were taken within the reverberant sound field of the room, rather than the direct sound field.

Table 4 and Figure 6 show the 1/3rd octave band reverberant sound pressure levels for each item of machinery measured.

It should be noted that the use of the jack hammer is only occasional, but is included in this assessment to demonstrate that the worst case is still acceptable.

Frequency (Hz)	Concrete Mixer	Beam Shaker	Jack Hammer
50	65.6	90.9	50.7
63	71.9	94.3	51.1
80	72.5	83.1	52.9
100	81.8	70.8	55.9
125	79.7	84	63.0
160	85.8	79.1	62.8
200	79.6	75.8	62.9
250	77.8	72.1	71.5
315	76.8	74.6	72.7
400	79.4	76.7	80.5
500	81.2	78.6	84.8
630	79.7	79.6	84.0
800	82.2	78.2	85.8
1000	84	78.3	82.6
1250	85.4	79.9	81.0
1600	87.7	79.8	82.2
2000	89.2	74.1	83.4
2500	87.5	72.3	81.2
3150	86.9	70.3	81.8
4000	88.2	67.5	83.9
5000	87.6	64.4	81.5
6300	84.3	61.1	85.7
8000	81.1	59.3	82.0
A-Weighted	**97.9**	**87.6**	**94.6**

Table 4 - Machinery Reverberant Sound Pressure Levels (dB)

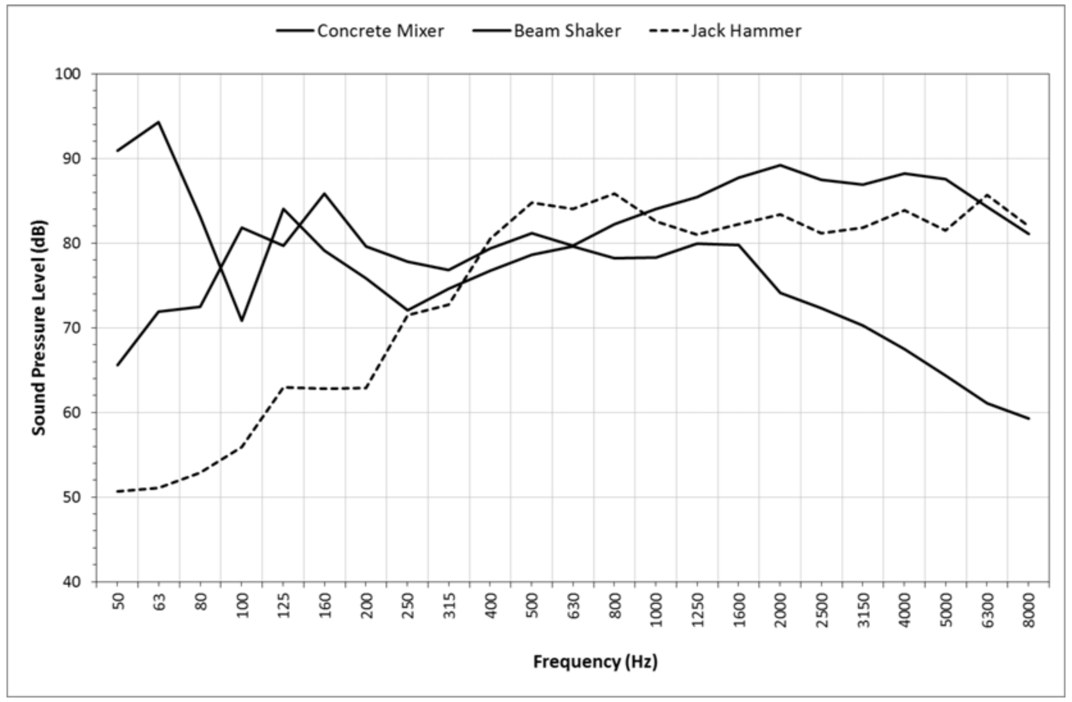


Figure 6 - Machinery Reverberant Sound Pressure Levels (dB)

5.2 Mechanical Plant Equipment Noise Levels

The complete extent and acoustic performance of mechanical plant is not finalised at this stage, however below is a summary of the main plant items that are expected to form part of a noise impact assessment:

- Ground floor internal plant room – Central heating & cooling plant
- Roof plant – Fume cupboard extract fan
- Local ventilation plant – A number of labs, offices and meetings contain local MVHR units and/or fan-coil units.

There are currently no emergency generators or large items of external plant equipment within the current proposals.

6.0 ACCESS ROAD NOISE LEVELS

British Standard 5228 Part 1: 2009 “Code of practice for noise and vibration on construction and open sites” has various information and guidelines on noise from plant, machinery and vehicles. Annex C of BS5228 provides “current sound level data on site equipment and site activities” and the relevant levels are reproduced below along with an average value which will be used for the assessment.

Table	Ref no.	Description	Power Rating [kW]	Weight [t]	Lmax at 10m [dB] in Frequency Octave Bands [Hz]								
					63	125	250	500	1k	2k	4k	8k	dBA
C.11	6	Lorry	343	29	92	82	76	78	77	76	74	68	83
C.11	16	Lorry	235	26	86	81	74	76	73	72	69	60	79
C.11	19	Lorry	201	26	87	76	73	81	79	75	68	62	83
C.11	20	Lorry	160	18	91	76	79	78	80	76	70	64	83
Average					**89**	**79**	**76**	**78**	**77**	**75**	**70**	**64**	**82**

Table 5 - BS5228-1 Lorry Lmax Levels

Noise levels of an idling vehicle (specifically a Dumper Truck in this case) can also be taken from Annex C of BS5228-1:2009 and are reproduced below:

Description	Leq at 10m [dB] in Frequency Octave Bands [Hz]								
	63	125	250	500	1k	2k	4k	8k	dBA
Idling Vehicle (BS5228-1 Table C.4 Ref 5)	73	64	55	55	60	56	50	43	63

Table 6 - BS5228-1 Idling Vehicle Leq

7.0 PROPOSED FAÇADE PERFORMANCE

The façade of the proposed building is approximately 78m from the façade of the nearest residential property and 60m from the garden boundary fence of the nearest residential property. The façade is specified to be constructed of the following elements:

Façade Element	Area (m^2)	Sound Reduction Rw (dB)	Transmission Coefficient, t	Area weighted transmission
Ventilation Opening	12	36	0.00025	0.0030
Glazing	28	41	0.00008	0.0022
Sliding Door	73	47	0.00002	0.0015
Solid Façade	82	47	0.00002	0.0016
Total	**195**	**43.7**	**0.00004**	**0.0083**
Formula	A	R	10^(-0.1 x R)	t x A

Table 7 - Proposed Façade Performance

Accounting for the area of the façade and external propagation over a distance of 60m there will be a weighted sound level difference between the internal reverberant noise level of the proposed building and the level at the garden boundary of the nearest residential property of 70dB.

Description	Formula	Reduction
Reverberant level to sound intensity in façade	10Log(4)	6dB
Sound reduction of facade	Refer to Table 7	43.7dB
Area source propagation to 2.9m	No attenuation from area source	0dB
Line source propagation to 6.4m	10Log(6.4/2.9)	3.5dB
Point source propagation to 60m	$10Log(60^2/6.4^2)$	19.5dB
Hemispherical propagation correction	-10Log(2)	-3dB
Total Attenuation		**70dB**

Table 8 - Facade Noise Propagation Calculation

8.0 ACCESS ROAD PROPERTIES

An assessment of the noise levels from deliveries using the proposed access road will be made at the nearest noise sensitive property which is approximately 78m from the engineering building façade and 57m from the access road (at its closest point). See Figure 8.

There is an earth mound between the engineering building and the nearest residents. At the area directly outside the structures lab, where deliveries are expected to be made, the mound is at a height of approximately 2m above ground level. Along the length of the access road, the height of the earth mound varies and a height of 1.5m above ground level is taken for the purposes of this assessment. Figure 7 shows the measured ground heights of the proposed service access road, the earth mound on the site boundary and the height of Clerk Maxwell road.

The height of the receptor point is taken as being at a first floor window, approximately 4.5m above ground level. It is understood that the ground height at the location of the sensitive receptor is approximately 1.4m lower than the reference ground height of the service road. Therefore the receptor is taken to be 3.1m.

Table 9 below summarises the distances and reference heights of the noise sensitive receptor locations.

Location Parameter	Residential Façade at 1st Floor	Residential Garden
Distance to engineering building	78m	60m
Distance to access road (closest point)	57m	47m
Assessment height	4.5m	1.5m
Assessment height relative to reference ground level	3.1m	0.1m

Table 9 - Location parameters of sensitive receptors

For the case of a vehicle moving along the access road, a correction is required to convert the Lmax value at 10m to an average (LAeq) value corresponding to the equivalent noise level of the vehicle moving along the access road. It is assumed that vehicles will travel at 20km/h along the access road. Equation F.6 from BS5228-1:2009 gives a method for calculating the equivalent continuous noise level from vehicles that pass along service roads at intervals. This equation will be used to assess the equivalent noise level at the nearest sensitive receptor. Calculation details are given in Section 9.4.

Additionally, it is assumed that vehicles will spend up to 10 minutes idling outside the engineering building. Vehicles will drive into the structures lab of the engineering building and the acoustic doors will be closed before any loading/unloading takes place. There will be no external loading or unloading of vehicles.

As per the methodology of BS4142, the specific sound source is to be evaluated over a reference time interval of 1 hour. It is currently assumed that there will be no more than 1 delivery vehicle within any 1 hour period.

The university have confirmed that there will be approximately 6 HGV (<30 tonne) deliveries per year and all other deliveries will be via light goods vehicles, typically small vans up to 3.5 tonnes.

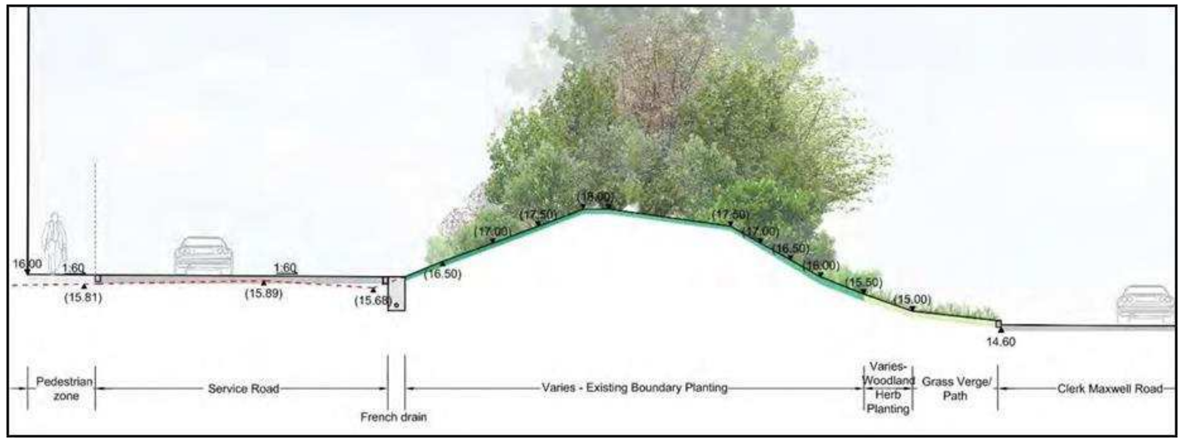


Figure 7 - Section showing relative ground heights

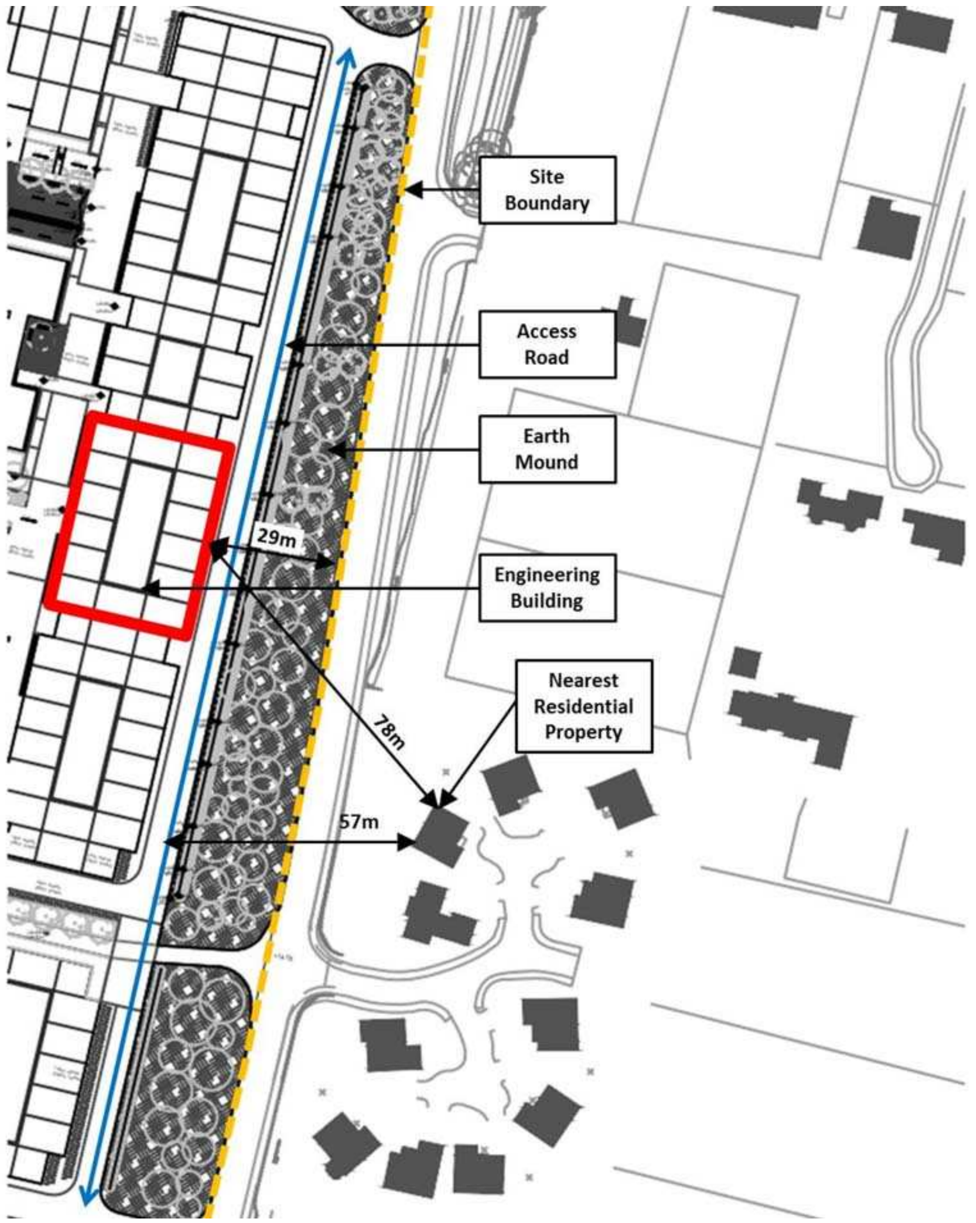


Figure 8 - Site Plan Showing Access Road

9.0 NOISE IMPACT ASSESSMENT

9.1 Engineering Machinery

All engineering machinery (concrete mixers, jack hammer, beam shaker etc.) will be operated internally within the proposed building only. Therefore, the composite façade sound reduction provides the primary means of mitigating any noise impact from this machinery.

The loudest piece of machinery measured was the concrete mixer with a reverberant sound pressure level of 97.9dBA. According to the method in Annex C of British Standard 4142:2014 there is no single 1/3rd octave band sound level that is sufficiently higher than its adjacent bands for the noise source to be considered tonal.

It is proposed that a 3dB penalty should be applied to account for the intermittent nature of the noise source and a further 3dB penalty applied to account for the impulsive nature of the noise source (This applies more to the jack hammer than the concrete mixer, but is applied as a worst case scenario).

Therefore, the noise rating level of the concrete mixer is 104dBA. Subtracting the sound level difference described in Section 7.0 of 70dB, the noise rating level at the garden boundary of the nearest residential property is expected to be 34dB. An assessment at the façade of the residential property would be marginally lower.

As per BS4142:2014, the noise rating level should be compared to the representative background noise level which has been measured to be 47dBA by taking the 40th percentile LA90,15min value.

This noise rating level is **13dBA below** the typical background noise level and easily achieves the target set out in Section 4.1 and is in accordance Cambridge Environmental Health noise impact criteria as detailed in Section 2.4 and 4.0. A summary of the noise rating level in comparison to background noise levels during various time periods is given in Table 10.

It can be seen that the noise rating level from machinery within the engineering building is below the typical background noise level at the boundary of the nearest residential property (garden boundary). However, it is not anticipated that any such machinery would normally be operated outside of the daytime period (8am to 6pm).

Time of Year / Week	Time Period	Typical Background Noise	Excess of Rating (34dBA) Over Background Sound Level
Busy Week	8am – 6pm	47 dBA	-13dBA
	6pm – 11pm	47 dBA	-13dBA
	11pm – 8am	43 dBA	-9dBA
Holiday Week	8am – 6pm	42 dBA	-8dBA
	6pm – 11pm	42 dBA	-8dBA
	11pm – 8am	40 dBA	-6dBA
Weekend	8am – 6pm	42 dBA	-8dBA
	6pm – 11pm	41 dBA	-7dBA
	11pm – 8am	37 dBA	-3dBA

Table 10 - Machinery Noise Impact Assesment

Uncertainty of the Assessment

The measurement of the background noise levels have been taken under repeatable conditions over an extended period of time (~190 hours) covering every day of the week, therefore it is expected that the uncertainty of the background noise level measurement will be very low.

Measurements of the machinery noise levels have been taken from the existing items that the University currently use and are understood to be the same items that will be used within the proposed building. However, the new structures lab is specified to have a much lower reverberation time than the existing building and so it is expected that the reverberant noise level within the structures lab may be up to 5dB less. Sound reduction data for the specified façade performance is taken from laboratory tests reports of the currently proposed products.

The excess of the rating level of the background sound level is -13dBA and so in this instance the uncertainty of the assessment does not have any significance to the outcome of the assessment.

9.2 Engineering Machinery Low Frequency Assessment

During discussions with Cambridge Environmental Services a query has been raised highlighting a concern as to whether low frequencies noise from the engineering machinery may result in a noise impact over above that identified by the A-weighted assessment.

This additional assessment has been included in order to present the anticipated low frequency noise levels at the nearest residents resulting from the use of engineering machinery.

The Beam Shaker was measured as having the highest reverberant sound pressure levels at 50Hz and 63Hz. These were 91dB and 94dB respectively as shown in Table 4. Applying the same characteristic penalties as discussed in Section 9.1 results in Noise Rating Levels of 97dB and 100dB at 50Hz and 63Hz respectively.

The frequency weighted sound reduction index of the façade is calculated to be 44dB in Section 7.0. At 50Hz and 63Hz this is expected to be 18dB with a resulting sound level difference between the internal reverberant noise level of the proposed building and the level at the garden boundary of the nearest residential property of 46dB.

Therefore, the noise rating level of the Beam Shaker at the garden boundary of the nearest residential property would be 51dB and 54dB at 50Hz and 63Hz respectively.

The measured 40th percentile daytime background noise level is 55dB and 54dB at 50hz and 60Hz respectively. Therefore, the low frequency component of the machinery noise level is not significantly above the measured background noise level and it is expected that there would be no adverse impact from low frequency noise.

It should also be noted that the anticipated low frequency noise level of the Beam Shaker at the garden boundary is at approximately the threshold of audibility.

9.3 Mechanical Plant Equipment

The complete extent and acoustic performance of mechanical plant is not finalised at this stage, however a description of the anticipated items of plant equipment are given in Section 5.2.

There are no large external items of plant or emergency generators within the current proposals. All mechanical ventilation units and fan coil units are located internally, local to each room. Therefore any noise impact can be mitigated by ensuring the appropriate selection of atmosphere side attenuators to each item of plant. There may be an externally located fume cupboard extract fan on the roof of the proposed building. If the sound power of this fan exceeds the noise limits then it will need to be mitigated with the use of screening or an acoustic enclosure.

Table 11 gives the total allowable sound power level from all items of plant in order to ensure that the typical background noise level is not exceeded. A margin of 3dBA has been given to allow for addition of engineering machinery noise levels and a distance of 60m has been assumed as the nearest noise sensitive receptor.

The allowable total plant sound power level has been calculated according to the following equation to account for distance propagation (no account of barrier effects have been taken to provide a worst case example).

Allowable Total Plant Sound Power = Limit at Garden Boundary – $10\text{Log}(2/(4\pi r^2))$

Time of Year / Week	Time Period	Typical Background Noise	Noise Rating Limit at Garden Boundary	Allowable Total Plant Sound Power
Busy Week	8am – 6pm	47 dBA	44dBA	88dBA
	6pm – 12pm	46 dBA	43 dBA	87dBA
	12pm – 8am	43 dBA	40 dBA	84dBA
Holiday Week	8am – 6pm	42 dBA	39 dBA	83dBA
	6pm – 12pm	42 dBA	39 dBA	83dBA
	12pm – 8am	40 dBA	37 dBA	81dBA
Weekend	8am – 6pm	42 dBA	39 dBA	83dBA
	6pm – 12pm	40 dBA	37 dBA	81dBA
	12pm – 8am	37 dBA	34 dBA	78dBA

Table 11 - Allowable Total Plant Sound Power Levels

9.4 Delivery Access Road

The noise level from a HGV vehicle moving along the delivery access road and idling outside the engineering building for 10 minutes has been assessed at both the garden boundary of the nearest residential building and the façade of the residential building at 1st floor level.

Table 12 and Table 14 give details of the LAeq,1hr calculation at the residential façade for a moving vehicle and an idling vehicle respectively. Table 16 combines the two LAeq,1hr levels to give a total noise level.

Table 13 and Table 15 give details of the LAeq,1hr calculation at the residential garden boundary for a moving vehicle and an idling vehicle respectively. Table 17 combines the two LAeq,1hr levels to give a total noise level.

	Residential Façade Level	63	125	250	500	1k	2k	4k	8k	dBA
a)	Lorry Lmax at 10m	89	79	76	78	77	75	70	64	82
	Values from BS5228-1 Table C.11. Refer to Table 5 for details									
b)	Lorry Sound Power, Lw	117	107	104	106	105	103	98	92	110
	Lw = Lmax at 10m – $10\text{Log}(2 / 4\pi r^2)$, where r is distance (10m)									
c)	Correction to Leq,1hr	-46	-46	-46	-46	-46	-46	-46	-46	
	As per method in BS5228 equation F.6 : -33 + 10log(Q) – 10Log(v), where Q is vehicles per hour (1), v is average speed (20km/h)									
d)	Distance Attenuation	-18	-18	-18	-18	-18	-18	-18	-18	
	-10Log(r), where r is distance (57m)									
e)	Barrier Attenuation	-5	-5	-5	-5	-5	-6	-7	-9	
	Barrier attenuation as per the Maekawa method: -10log(3 + 20N), N = Δd(2/λ), path difference = 0.0045m									
f)	Reflection Correction	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
	Correction for reflection from façade of engineering building									
g)	Leq,1hr at Receptor	**51**	**41**	**38**	**40**	**38**	**36**	**30**	**22**	**43**
	Leq,1hr at receptor = b + c + d + e + f									

Table 12 - Calculation of LAeq,1hr levels at residential façade from moving vehicle

	Residential Garden Boundary	63	125	250	500	1k	2k	4k	8k	dBA
a)	Lorry Lmax at 10m	89	79	76	78	77	75	70	64	82
	Values from BS5228-1 Table C.11. Refer to Table 5 for details									
b)	Lorry Sound Power, Lw	117	107	104	106	105	103	98	92	110
	Lw = Lmax at 10m – $10\text{Log}(2 / 4\pi r^2)$, where r is distance (10m)									
c)	Correction to Leq,1hr	-46	-46	-46	-46	-46	-46	-46	-46	
	As per method in BS5228 equation F.6 : -33 + 10log(Q) – 10Log(v), where Q is vehicles per hour (1), v is average speed (20km/h)									
d)	Distance Attenuation	-16	-16	-16	-16	-16	-16	-16	-16	
	-10Log(r), where r is distance (40m)									
e)	Barrier Attenuation	-5	-6	-7	-9	-11	-13	-16	-18	
	Barrier attenuation as per the Maekawa method: -10log(3 + 20N), N = Δd(2/λ), path difference = 0.0705m									
f)	Reflection Correction	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
	Correction for reflection from façade of engineering building									
g)	Leq,1hr at Receptor	**52**	**41**	**37**	**38**	**35**	**31**	**23**	**14**	**40**
	Leq,1hr at receptor = b + c + d + e + f									

Table 13 - Calculation of LAeq,1hr levels at residential garden boundary from moving vehicle

	Residential Façade Level	63	125	250	500	1k	2k	4k	8k	dBA
a)	Idling Leq at 10m	73	64	55	55	60	56	50	43	63
	Values from BS5228-1 Table C.4.									
b)	Correction to Leq,1hr	-8	-8	-8	-8	-8	-8	-8	-8	
	As per BS4142: 10Log(Ton / Tref), where Ton is on time (10 minutes) Tref is reference time (60 minutes)									
c)	Distance Attenuation	-18	-18	-18	-18	-18	-18	-18	-18	
	-20Log(r1/r2), where r1 is original distance (10m) and r2 is new distance (76m)									
d)	Barrier Attenuation	-5	-6	-6	-7	-9	-11	-13	-16	
	Barrier attenuation as per the Maekawa method: -10log(3 + 20N), N = Δd(2/λ), path difference = 0.0403m									
e)	Reflection Correction	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
	Correction for reflection from façade of engineering building:									
f)	Leq,1hr at Receptor	**45**	**36**	**26**	**25**	**28**	**22**	**14**	**4**	**31**
	Leq,1hr at receptor = a + b + c + d + e									

Table 14 - Calculation of LAeq,1hr levels at residential façade from idling vehicle

	Residential Garden Boundary	63	125	250	500	1k	2k	4k	8k	dBA
a)	Idling Leq at 10m	73	64	55	55	60	56	50	43	63
	Values from BS5228-1 Table C.4.									
b)	Correction to Leq,1hr	-8	-8	-8	-8	-8	-8	-8	-8	
	As per BS4142: 10Log(Ton / Tref), where Ton is on time (10 minutes) Tref is reference time (60 minutes)									
c)	Distance Attenuation	-15	-15	-15	-15	-15	-15	-15	-15	
	-20Log(r1/r2), where r1 is original distance (10m) and r2 is new distance (58m)									
d)	Barrier Attenuation	-6	-7	-8	-10	-12	-15	-18	-20	
	Barrier attenuation as per the Maekawa method: -10log(3 + 20N), N = Δd(2/λ), path difference = 0.1154m									
e)	Reflection Correction	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
	Correction for reflection from façade of engineering building: 10Log(2)									
f)	Leq,1hr at Receptor	**47**	**37**	**26**	**25**	**27**	**21**	**12**	**2**	**31**
	Leq,1hr at receptor = a + b + c + d + e									

Table 15 - Calculation of LAeq,1hr levels at residential garden boundary from idling vehicle

Residential Façade Level	63	125	250	500	1k	2k	4k	8k	dBA
Moving Vehicle Leq,1hr	51	41	38	40	38	36	30	22	43
Idling Vehicle Leq,1hr	45	36	26	25	28	22	14	4	31
Total Leq,1hr	52	42	38	40	39	36	30	22	**43**

Table 16 – Total LAeq,1hr level at residential façade

Residential Garden Boundary	63	125	250	500	1k	2k	4k	8k	dBA
Moving Vehicle Leq,1hr	52	41	37	38	35	31	23	14	**40**
Idling Vehicle Leq,1hr	47	37	26	25	27	21	12	2	**31**
Total Leq,1hr	53	43	38	38	36	31	23	14	**40**

Table 17 - Total LAeq,1hr level at residential garden boundary

It can be seen that the most onerous condition is at the façade of the residential building at 1st floor level. Although this assessment location is further away from the access road, it has a reduced barrier effect from the mound due to being assessed at 1st floor level. The noise level to be compared to the typical background noise level is LAeq,1hr = 43dB.

Time of Year / Week	Time Period	Typical Background Noise	Excess of Rating Over Background Sound Level
Busy Week	8am – 6pm	47	-4dBA
	6pm – 11pm	47	-4dBA
Holiday Week	8am – 6pm	42	1dBA
	6pm – 12pm	42	1dBA
Weekend	8am – 6pm	42	1dBA
	6pm – 12pm	41	2dBA
Saturdays	9am – 1pm	42	1dBA

Table 18 – Access Road Noise Impact Assessment

Table 18 gives a comparison of the vehicle noise level at the residential boundary to the typical background noise levels at various time periods. During holiday periods when ambient traffic noise is less

The university are proposing to limit delivery periods to Mon-Fri 8am to 6pm and Saturdays 9am to 1pm. These time periods are highlighted in Table 18. It can be seen that the vehicle noise level exceeds the typical background noise level by no more than 1dBA during holiday weekdays and Saturday mornings. This small exceedance is to be mitigated by minimising the number of such deliveries.

This assessment is based upon the worst case scenario of an articulated lorry (<30 tonne). All other deliveries to the building will be made by a small van and noise levels from such a vehicle are expected to be much lower (by at least 5dBA) and always less than the typical background noise level.

Guidance for assessing the impact of noise is given in Section 11 of BS4141:2014 and states that:

> *"The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating*

level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context"

Values of +5db and +10dB are suggested to be indications of an adverse or significant adverse impact, respectively, depending on the context.

In this case the assessment of impact needs to be modified due to context and the following factors should be considered:

Absolute Sound Level
BS4142 suggests that "where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background." The World Health Organisation (WHO) guidelines for community noise suggest that sound level at the façade of dwellings should not exceed 45dB LAeq so as to avoid sleep disturbance, with a 5dB increase during the day. The background noise level and vehicle noise level are both lower than this value giving an indication that the absolute sound levels are low and unlikely to cause disturbance.

Frequency of Noise Events
The university have advised that deliveries from HGV (articulated lorries) are likely to occur approximately only 6 times per year. This means that a HGV delivery event would happen on <2% of days within a year and only once within that day. Therefore these events can be considered to be very rare and less likely to have adverse effect than an equivalent noise source that is heard every day.

Character and Level of the Residual Sound Compared to the Specific Sound
BS4142 suggests that may be beneficial "to assess the degree to which the specific sound source is likely to be distinguishable and will represent incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound."

Traffic noise is the major component of both the specific noise and the residual sound, it is also apparent that the specific noise source is less than the residual sound level. Therefore the specific sound source would be expected to be less distinguishable and not an incongruous sound.

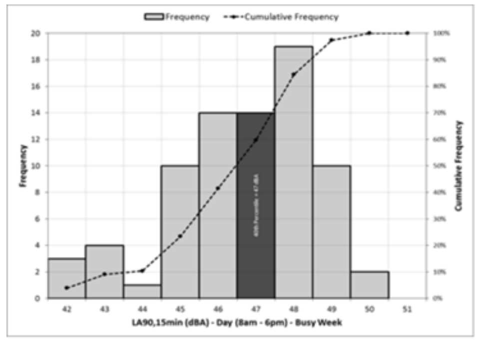
The university are taking reasonable steps to improve the situation for the nearest residents by providing an access road to take vehicles off, further away and screened from, Clerk Maxwell Road and providing an internal area to unload vehicles. In light off this and the contextual factors described above it is proposed that the noise level from deliveries is acceptable providing the following conditions which shall be written into the universities "Servicing and Operational Management Plan":

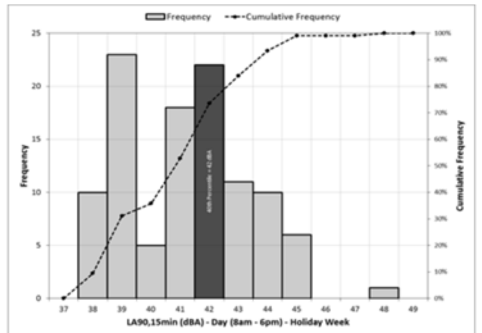
- Typically 1 delivery per day from a small van
- Approximately 6 HGV deliveries per year
- Weekday deliveries between 8am – 6pm
- Saturday deliveries between 9am – 1pm
- No deliveries on Sundays
- All unloading must be done inside the structures lab with acoustic doors closed
- A banksman shall be used when possible to avoid the need for reversing alarms

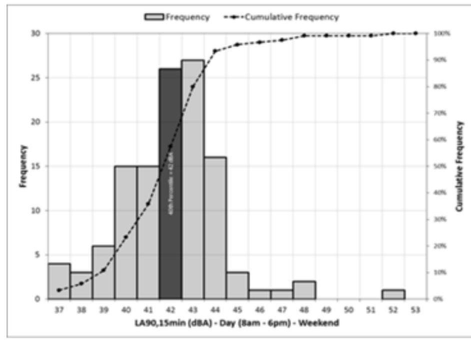
Uncertainty of the Assessment
The measurement of the background noise levels have been taken under repeatable conditions over an extended period of time (~190 hours) covering every day of the week, therefore it is expected that the uncertainty of the background noise level measurement will be very low.

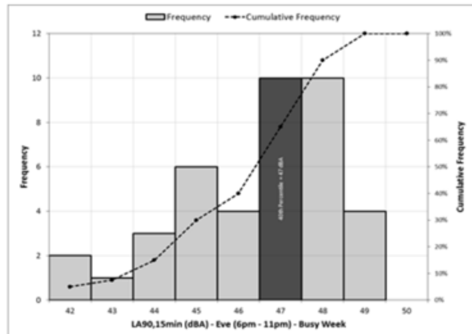
Measurements of the actual vehicles that will be using the service road is not possible at this stage and published sound levels of sub-30 tonne HGV Lorries are taken from BS5228 with an average of 4 values used. The range of values was 4dBA (+1dBA and -3dBA from the average).

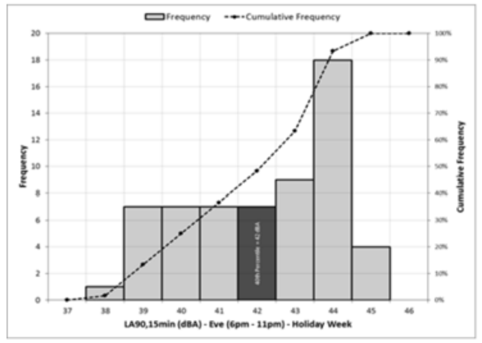
10.0 APPENDIX A – BACKGROUND NOISE LEVEL HISTOGRAMS

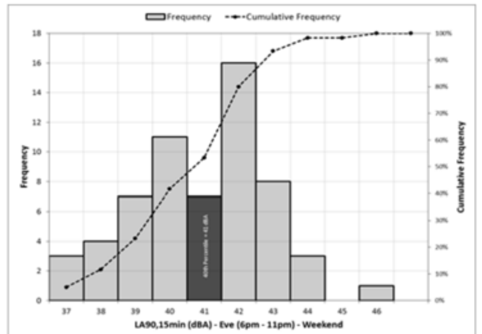


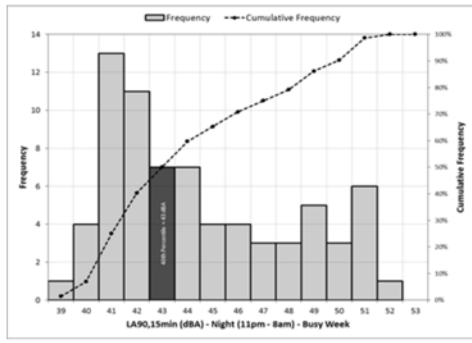


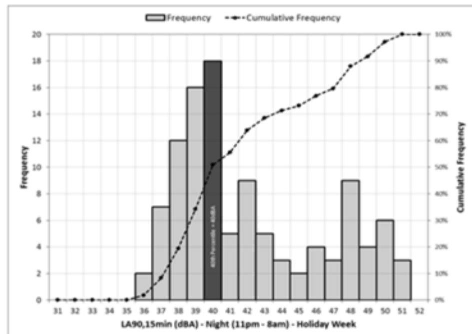


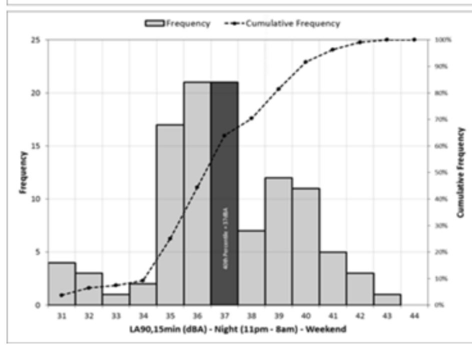












11.0 APPENDIX B – GLOSSARY OF ACOUSTIC TERMS

Sound Pressure Level, SPL or L_p (decibels, dB)

A measure of the instantaneous sound pressure at a point in space. The threshold of hearing occurs at approximately SPL=0 dB (which corresponds to a reference sound pressure of 20μPa).

LP(dB)=20.log10(Measured RMS Sound Pressure (Pa)/20μPa)

where RMS Sound Pressure is the Root-mean-square of the sound pressure at a point, relative to mean atmospheric pressure, over a time period defined by the sound level meter used.

A-Weighted Sound Pressure Level, L_A (dBA)

SPL values are weighted in a way that approximates the frequency response of the human ear and allows sound levels to be expressed as a single figure value.

Equivalent Continuous A-Weighted SPL, $L_{Aeq,T}$ (dBA)

Energy average of the A-weighted sound pressure level over a time period, T. The level of a notional continuous sound that would deliver the same A-weighted sound energy as the actual fluctuating sound over the course of the defined time period, T

Background Noise Level A-Weighted $L_{A90,T}$ (dBA)

A-weighted sound pressure level that is exceeded 90% of the time.

Maximum A-Weighted SPL, L_{AFMax} (dBA)

Maximum A-weighted sound pressure level measured with fast time weighting

Frequency, f (Hertz, Hz)

The rate of vibration of air molecules which transmit the sound measured in cycles per second or Hertz. The human ear is generally sensitive to sound in the range 20Hz – 20kHz.

12.0 APPENDIX C – VIBRATION IMPACT ASSESSMENT

smithandwallwork engineers

Cambridge University – New Civil Engineering Building at West Cambridge

Ground vibration planning statement

Simon Smith 7th October 2016 (rev 1)

Introduction

This brief report describes the vibration surveys carried out as part of the plans for the relocation of the main structures lab from Trumpington Street to the new Civil Engineering Building proposed at West Cambridge. It also describes vibration isolation measures proposed in the new building.

The report concludes with a review and assessment of the likely vibration dose values achieved at the site boundary in accordance with BS 6472-1:2008 *'Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting'*.

BS 6472 provides guidance on predicting human response to vibration in buildings over the frequency range 0.5 Hz to 80 Hz. Frequency weighting curves for human beings exposed to whole-body vibration are included, together with advice on measurement methods to be employed. Methods of assessing continuous, intermittent and impulsive vibration are presented.

BS 6472 describes how to determine the vibration dose value, VDV, from frequency-weighted vibration measurements. The vibration dose value is used to estimate the probability of adverse comment which might be expected from human beings experiencing vibration in buildings. Consideration is given to the time of day and use made of occupied space in buildings, whether residential, office or workshop.

It should be noted that the primary driver for in depth vibration surveys carried out to date has been to assess the impact of potential activities in the main structures lab on nearby lab equipment in the Graphene Centre, Nanoscience and indeed within the new Civil Engineering Building.

Surveys

Two vibration surveys have been carried out to date:

- At the existing structures lab facilities at Trumpington Street (to determine the level of likely vibration generating activities).
- At the proposed site to establish background levels of site vibration and to carry impact tests to mimic the likely levels of ground vibration (from the operation of the new structures lab).

New Civil Engineering Building

The new Civil Engineering Building will incorporate the main structures lab. The main strong floor and concrete lab are both designed to incorporate vibration isolation measures which will reduce the transmission of vibration within the new building as well to adjacent soil and hence building properties.

Assessment of Survey Results

The results of the surveys show that there is little to no impact on the sensitive lab equipment in the Graphene Centre and Nanoscience under daily activities that are envisaged within the new Civil Engineering Building.

When assessing the results of the surveys in relation to the residential properties (human exposure) in Clerk Maxwell Road (for which the survey was not originally intended) it is possible to use BS 6472-1:2008 to provide an assessment of ground vibration from the new Civil Engineering Building.

From the site vibration survey it can be seen that at the boundary to Clerk Maxwell Road we achieve VC-D which is equivalent to a velocity of $6.25x10^{-6}$ m/s (rms at one-third octave for frequencies 1-100Hz).

Referencing annex C4 of BS 6472 it can be seen that the vibration dose value can be derived using rms acceleration:

$$\mathrm{eVDV} = 1.4 \times a(t)_{\mathrm{r.m.s.}} \times t^{0.25}$$

From the survey results it can be seen that the dominant frequency is in the 20Hz range and as such the VC-D criteria relates to an acceleration of $0.0008ms^{-2}$.

The weighting value that is applied to this rms acceleration varies according to the number of occurrences and duration of each vibration event. As we are dealing with envisaged activities and not actual insitu site measurements it would be prudent to assume a high magnitude of weighting and apply it to estimate a vibration dose value. In this instance a weighting value of 10 (ie 10 occurrences each 6 minute duration) will be taken which gives a vibration dose value of $0.008ms^{-1.75}$.

As can be seen from table 1 of BS 6472 (extract below) this is within acceptable limits for both day and night activites.

Table 1 **Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings**

Place and time	Low probability of adverse comment $m \cdot s^{-1.75}$ 1)	Adverse comment possible $m \cdot s^{-1.75}$	Adverse comment probable $m \cdot s^{-1.75}$ 2)
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Extract BS 6472-1:2008

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CAMBRIDGE UNIVERSITY ENGINEERING DEPARTMENT

Vibration Transmission Survey

30 August 2016

Delivered by email to: Simon Smith, Smith & Wallwork Engineers

TABLE OF CONTENTS

2 EXECUTIVE SUMMARY

2.1 This report has been prepared under instruction from Smith & Wallwork Engineers, and is intended to form part of a strategy for planning the phase 1 building (Civil Engineering building) of Cambridge University Engineering Department’s long term plans to relocate to the West Cambridge Site. The Civil Engineering Building will house the structures lab including the strong floor as well as other research activities.

2.2 The proposed site of the Civil Engineering Building lies close to the existing Electrical Engineering Division Building, which houses the Cambridge Graphene Centre, as well as the Nanoscience Centre. Both the Graphene Centre and the Nanoscience Centre employ test and manufacturing equipment and processes that are sensitive to disturbance from vibration.

2.3 The current structures lab is located within the Department of Engineering Building on Trumpington Street, Cambridge. A number of activities and equipment are in use that, when relocated to the new site, generate vibration levels that will propagate to the neighbouring Cambridge Graphene Centre and/or the Nanoscience Centre.

2.4 Vibration levels were measured in the current lab in February 2016 and documented in a Part 1 report [2] (Source Vibration Levels of Structures Lab Activities dated 9 March 2016) to provide source vibration level input for the design of the new Civil Engineering Building. Acceleration levels and frequency content were measured close to the machines used in the structures lab to characterize the vibration sources:

- whether the vibration levels generated will impact on the new building design (in terms of building occupants).
- whether the vibration levels generated will impact on the new building design (in terms of vibration sensitive equipment in the new Civil Engineering Building).
- the typical vibration generated by the machines and transmitted into the strong floor of the structures lab.
- the pattern of use of the machines and the worst case scenarios during normal use of the lab.

2.5 This Part 2 of the survey presents background level vibration survey results and documents the transmission of ground-borne vibration caused by known impact on the ground in the location of the new structures lab. The source was designed to approximate the impact of typical activities in the structures lab. The results are presented in two ways:

- transmission loss as a function of distance -- to enable calculation of transmission from different sources at different distances;
- direct measurement of vibration levels in the existing Graphene and Nanoscience Centres.

2.6 The background vibration levels measured in the Graphene Centre and Nanoscience Centre are lower than the minimum requirements. The results were obtained by averaging in time the vibration levels for the duration of the measurements.

2.7 The vibration level for the impacts peaked near the source in the 31.5 Hz frequency band, and this carries through transmission as the maximum frequency.

2.8 The vibration level decreases with distance from 5 dB/m at 5Hz to 8 dB/m 80Hz

2.9 Vibration received in the Graphene Centre in EBL and Electronics Lab was below the VC-E criteria for 98, 196, 392 Joule impact and below VC-D for 1,568 Joule impact.

2.10 Vibration received in the Graphene Centre in SEM room was above the VC-E criteria for 98, 196 Joule impact and above VC-D for 392 and 1,568 Joule impact.

2.11 Vibration received in the Nanoscience Centre TEM room (Module 1) was below the VC-C criteria for 784 and 1,568 Joule impact. Vibration levels for lower impact energy could not be measured since the impulsive signal was below the background levels.

2.12 Vibration received in the Nanoscience Centre SEM room was below the VC-C criteria for 784 Joule impact and above VC-C criteria for 1,568 Joule impact. Vibration levels for lower impact energy could not be measured since the impulsive signal was below the background levels.

2.13 Vibration received in the Nanoscience Centre EBL room was below the VC-C criteria for 784 and 1,568 Joule impact. Vibration levels for lower impact energy could not be measured since the impulsive signal was below the background levels.

2.14 The highest vibration velocity of 18.5 um/s , over 3.12 um/s (VC-E), was received in the Graphene Centre room housing the Scanning Electron Microscope (SEM) for the highest impact energy of 1,568 Joule. However, this did not disturb the use of the SEM, which is mounted on an isolation table.

2.15 The highest velocity of 12.3 um/s measured on the floor of the Nanoscience Centre TEM Module 1 room was attenuated by the isolation joint in the slab surrounding the sensitive equipment. A similar machine is already installed in the room next to the measured one and lies on a similar isolation system. The machine was running during tests and it did not experience any disturbance. It is believed that the internal isolation system of the machine is robust enough to attenuate such vibration levels.

2.16 This survey report is concerned with the operation of the new Civil Engineering Building and does not extend in scope cover the construction of the new building and the vibration likely to be generated during the build process.

3 REFERENCE DOCUMENTS

1. H. Amick, M. Gendreau, T. Busch, and C. Gordon, “Evolving criteria for research facilities: vibration,” *Proceedings of SPIE Conference 5933: Buildings for Nanoscale Research and Beyond*, San Diego, CA, 31 Jul 2005 to 1 Aug 2005
2. Sound Space Vision, “Source Vibration Levels of Structures Lab Activities*”, Part 1 Report,* 9 Mar 2016
3. Trethewey, Martin W. "Structural impact testing force spectra." *Proceedings of SPIE, the International Society for Optical Engineering. Vol. 3089. Society of Photo-Optical Instrumentation Engineers,* 1997.

4 INTRODUCTION

4.1 This report has been prepared under instruction from Smith & Wallwork Engineers, and is intended to form part of a strategy for planning the phase 1 building (Civil Engineering Building) of Cambridge University Engineering Department’s long term plans to relocate to the West Cambridge site. The Civil Engineering Building will house the structures lab including the strong floor as well as other activities.

4.2 In a previous report (Part 1) [2] measurements of vibration velocity were made on the floor of the existing structures lab at Trumpington Street for use as input into a transmission model.

4.3 In this survey (Part 2) impulse response measurements were made to survey the vibration transmission characteristics of the ground on the proposed site of the new Civil Engineering Building and to inform predictions of the impact of the new building on sensitive equipment and activities in the Graphene Centre (Electrical Engineering Division Building) and the Nanoscience Centre.

4.4 The sensitive equipment includes Scanning Electron Microscope (SEM), Tunnelling Electron Microscope (TEM) and Electron-beam Lithography system (EBL). The high precision of these machines requires very low ambient vibration, defined in terms of a group of vibration criteria VC-A to VC-E. These are not concerned with human response to vibration but with machine tolerance. The specifications for these machines range from VC-C to VC-E (Figure 4.1).

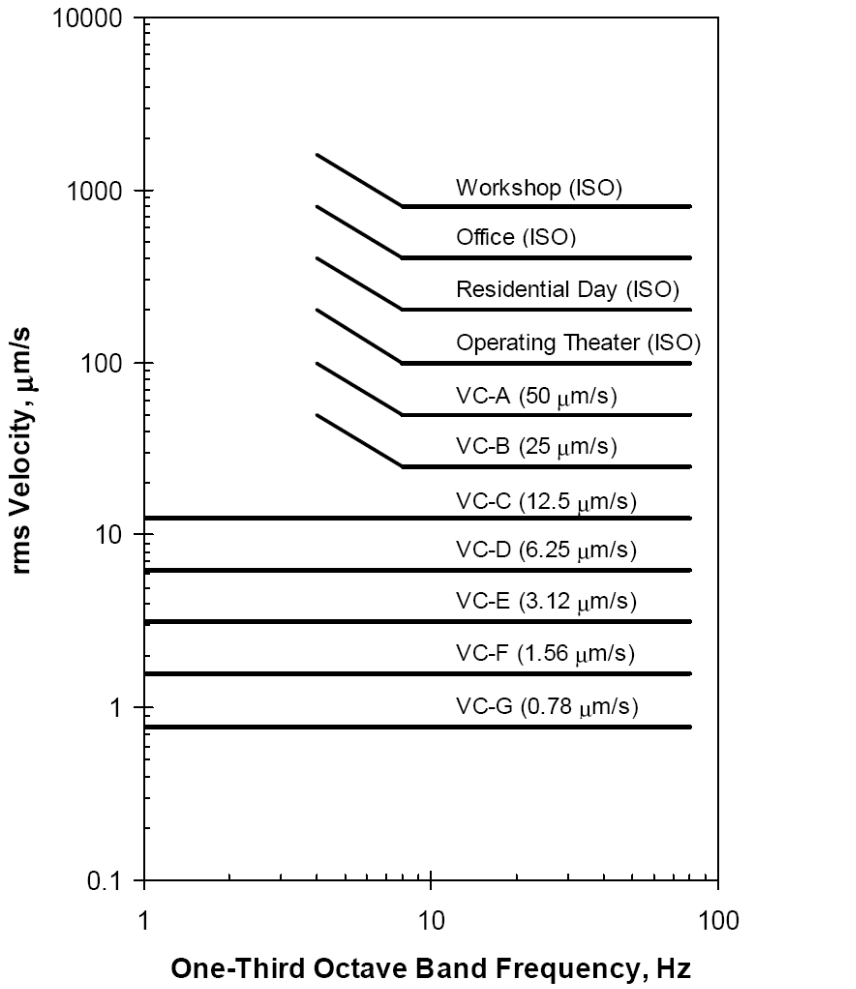

Figure 4.1 – Generic vibration criterion (VC) curves for vibration-sensitive equipment.

4.5 The VC criteria are defined in terms of RMS vibration velocity. As such, they are most relevant and most often used in relation to continuous signals, not short impulses. Our test signal is an impulse, typically about 0.5 seconds in duration. RMS velocity is calculated in 1/3 octave bands from a 2-second window of acceleration signal and compared to the VC criteria.

4.6 This report includes the methodology and results of the measurements, but not all the details of the signal processing.

5 BACKGROUND VIBRATION

5.1 The site was visited on 20/08/2016 by Fabrizio D'Amelio to measure background floor vibration in the Graphene Centre and the Nanoscience Centre.

5.2 Tests were made using a Dytran 3191A1 single axis accelerometer and Benstone Impaq Elite signal analyser. The combination had an analogue bandwidth from 1 to 500 Hz.

5.3 Unless stated otherwise, the accelerometer was mounted on a bespoke 3-point support plate, with the axis oriented vertically. The measurements were taken in one position close to the

SOUND SPACE VISION / SOURCE VIBRATION LEVELS OF STRUCTURES LAB, CUED

mountings of the machines (approx. 20 cm) and the same positions were subsequently used for later impact tests.

5.4 Sample rate 1000 Hz. Integration from acceleration to velocity spectrum was stored each 1.6s, with frequency resolution 0.625 Hz.

5.5 30 minutes continuous samples were recorded in the Graphene Centre for EBL and SEM machines, giving 2184 short time FFT spectra each. The sensor was placed near the mountings of the machines on the concrete plinth that will support the EBL machine and on the finishes of the SEM floor. The concrete plinth is cast monolithic with the main building raft foundation.

5.6 Continuous samples 20 minutes long were recorded in the Nanoscience Centre for three different machines, namely, EBL (Bay 1), TEM (module 1). Measurements were made both on the isolation block that circumscribes the machines and outside the isolation block, giving 1456 short time FFT spectra each. A 10 minutes measurement, 728 short time FFT spectra, was conducted instead at the SEM machine both on the isolated block and on the main non isolated floor. In all cases, the accelerometers were placed on the floor finishes.

5.7 RMS velocity at each 1/3 octave band was averaged over the duration of the measurement.

5.8 The results obtained are plotted against VC-E curve which is the maximum allowed vibration level of the structure containing the machines under analysis [1]. The Electronics Lab has a VC-C requirement. To the best of our knowledge, VC-E threshold is applied to the machines measured in the Nanoscience Centre.

5.9 Figure 5.1 shows the positions of the sensors in the Graphene Centre, while, Figure 5.2 shows the position of the sensors in the Nanoscience Centre.

5.10 Figure 5.3 to 5.6 show the background levels measured in the Graphene and Nanoscience centres.

5.11 Figure 5.7 to 5.10 show additional short term (60s Graphene Centre, 16s Nanoscience Centre) background measurements made on 26/07/2016, the same day of impact tests. These measurements show very similar results at the Graphene Centre but slightly differ at the Nanoscience Centre. In the latter case, a higher background noise was experienced on the drop test day. The numerous machines and building services in the building might have affected the short term measurement.

5.12 Figure 5.11 to 5.13 show the time trace of the background noise in both the Graphene Centre and the Nanoscience Centre. The module in frequency of velocity is shown in time and no particular patterns can be detected during the time of measurements.

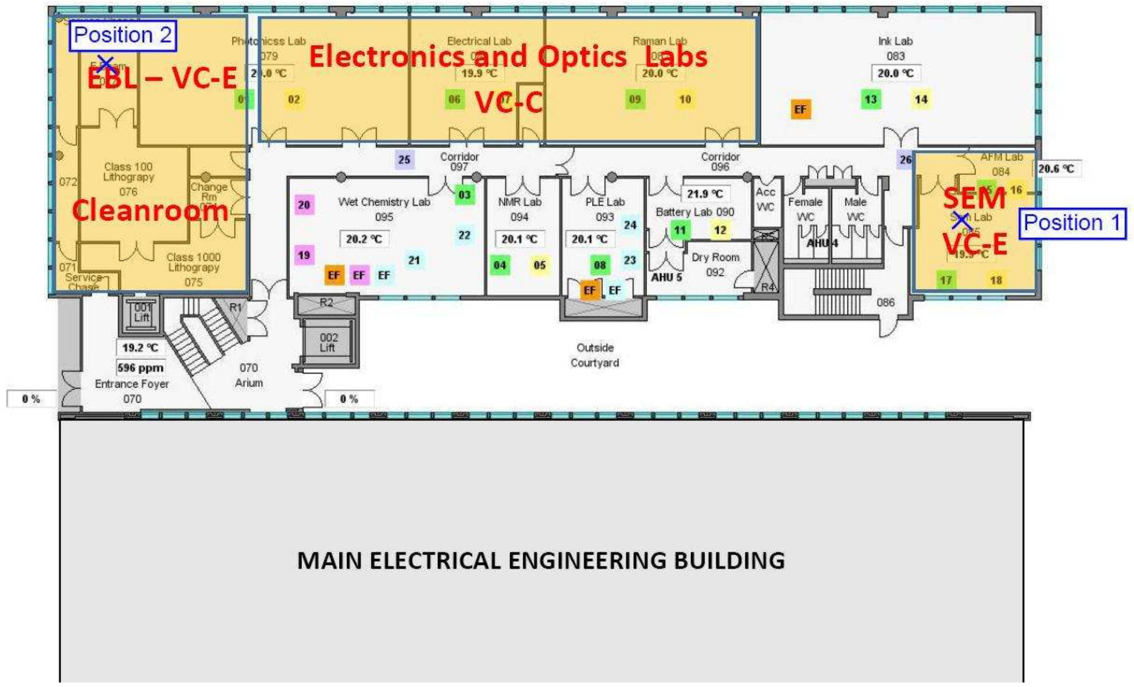

Figure 5.1 – Mark-up of measurement positions in Graphene Centre plan.

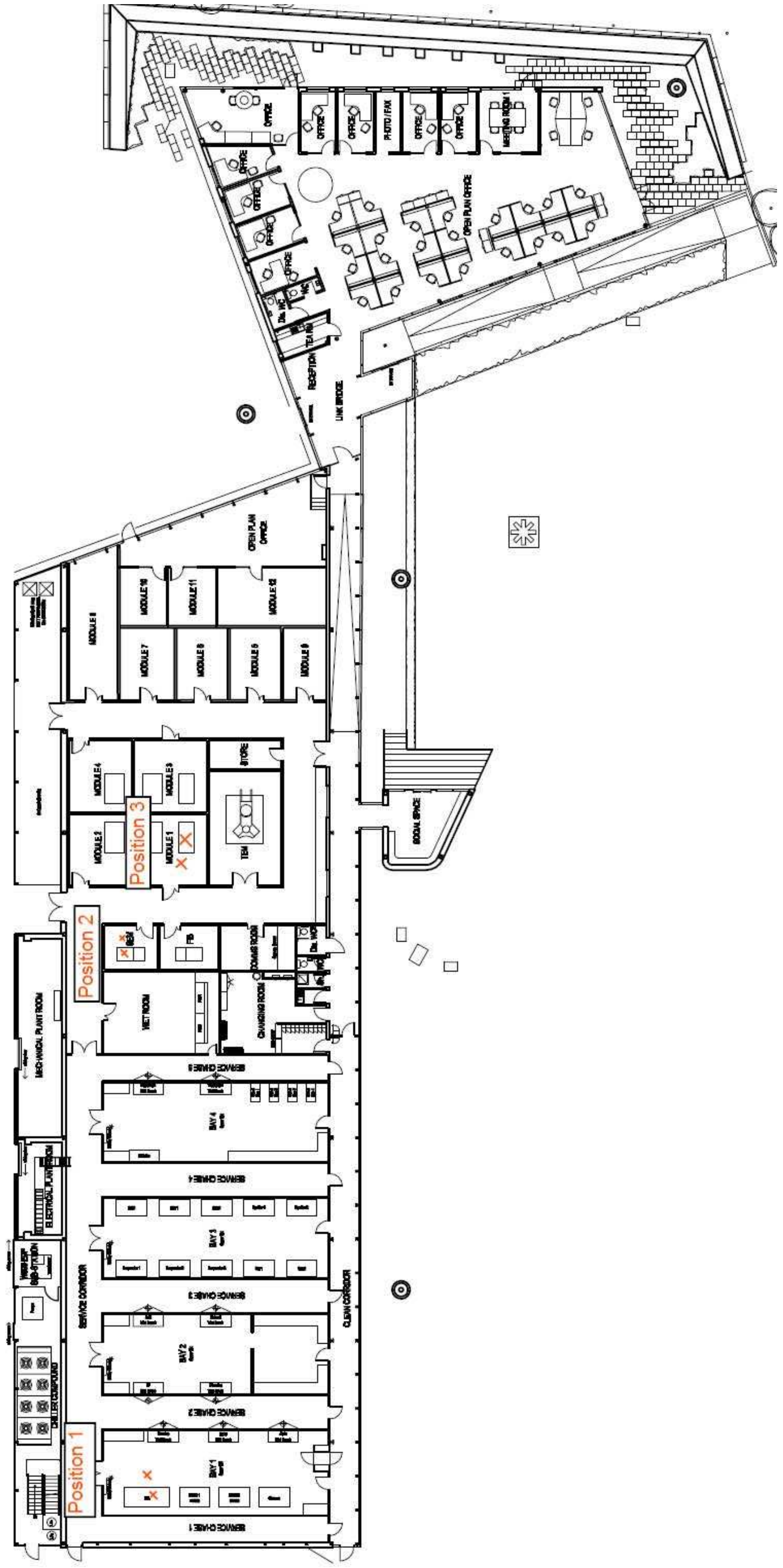

Figure 5.2 – Mark-up of measurement positions in Nanoscience Centre plan.

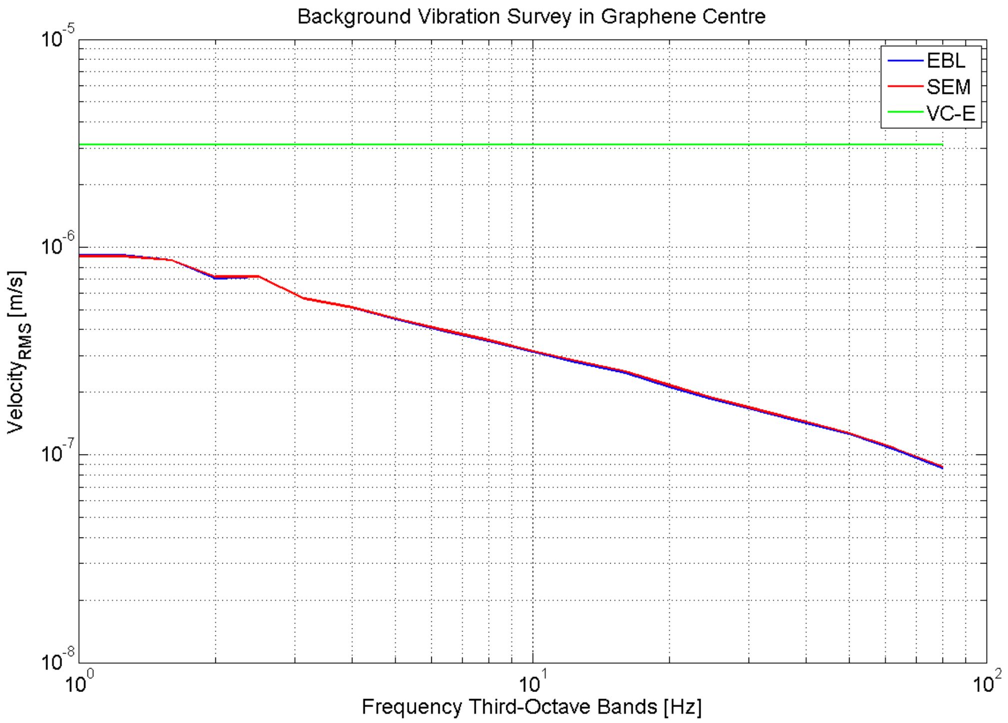

Figure 5.3 – Long term background vibration levels measured in the Graphene Centre.

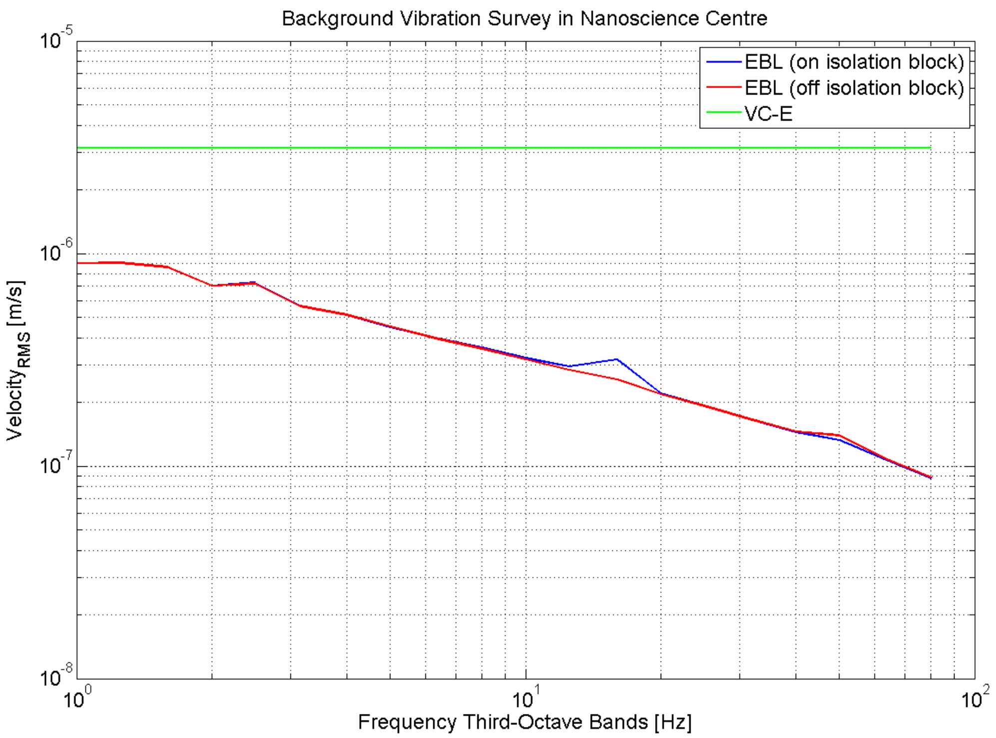

Figure 5.4 – Long term background vibration levels measured at EBL in the Nanoscience Centre.

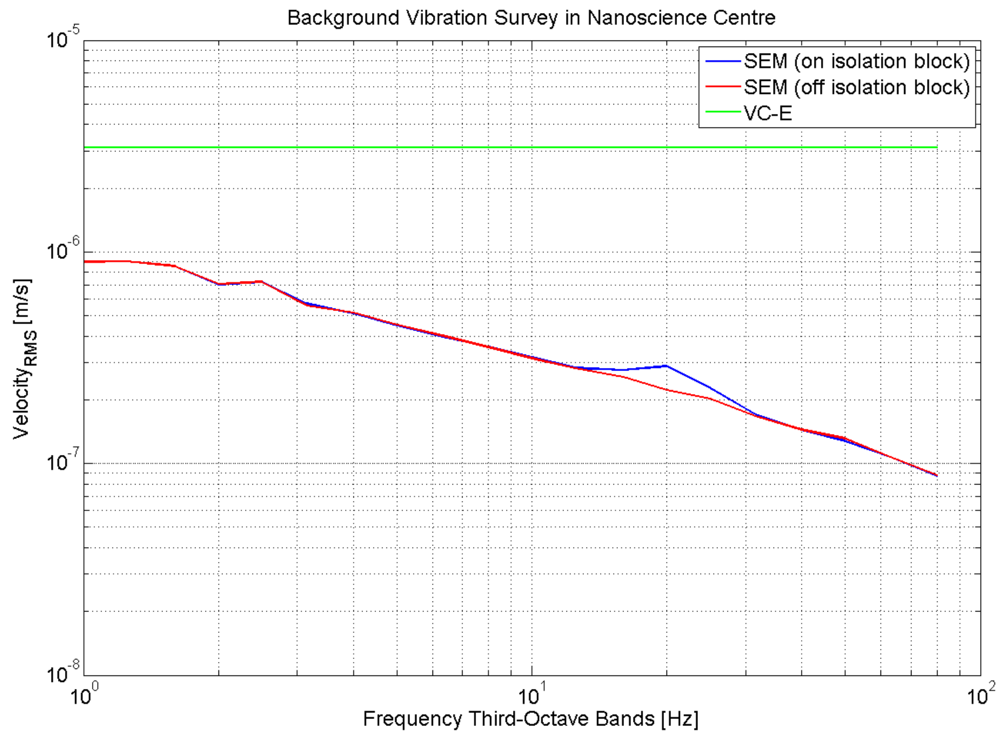

Figure 5.5 – Long term background vibration levels measured at SEM in the Nanoscience Centre.

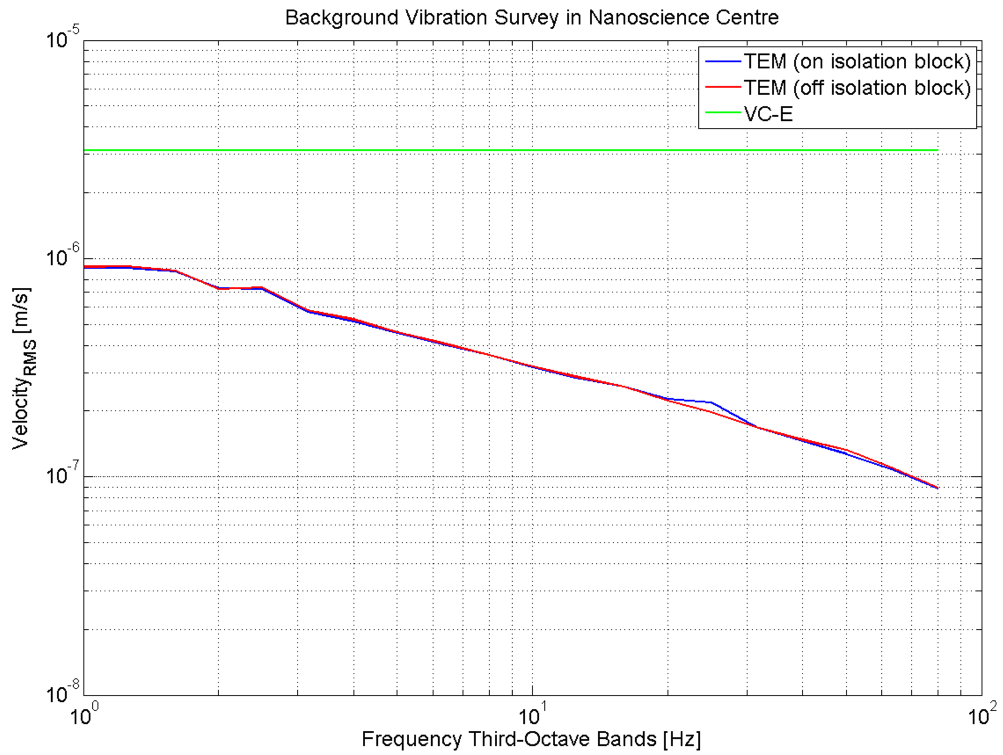

Figure 5.6 – Long term background vibration levels measured at TEM (Module 1) in the Nanoscience Centre

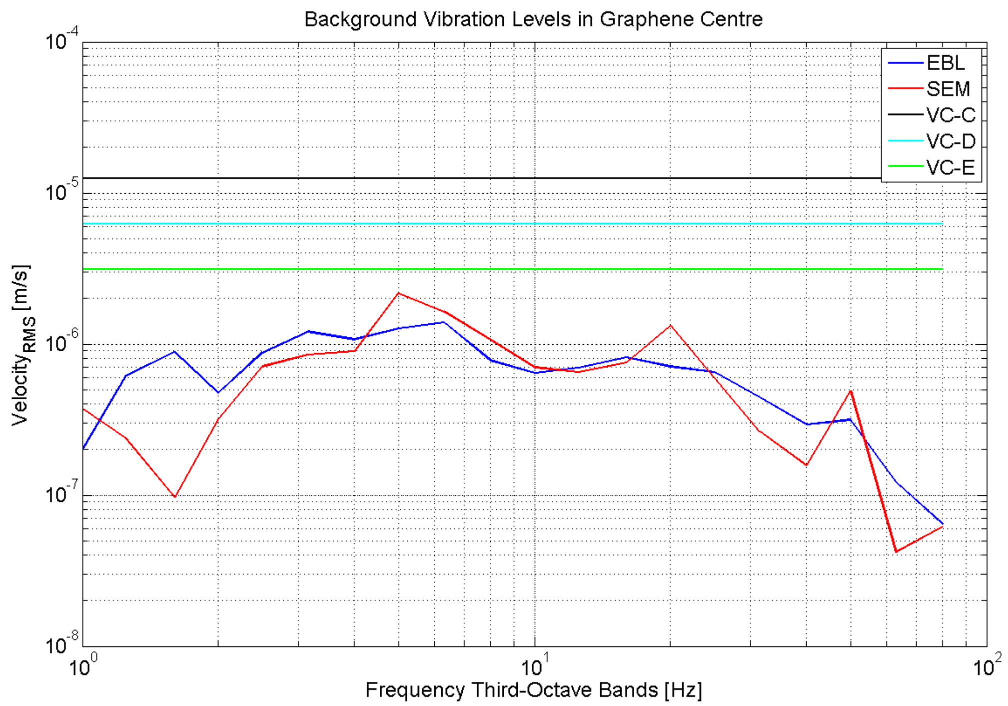

Figure 5.7 – Short term background vibration levels measured in the Graphene Centre.

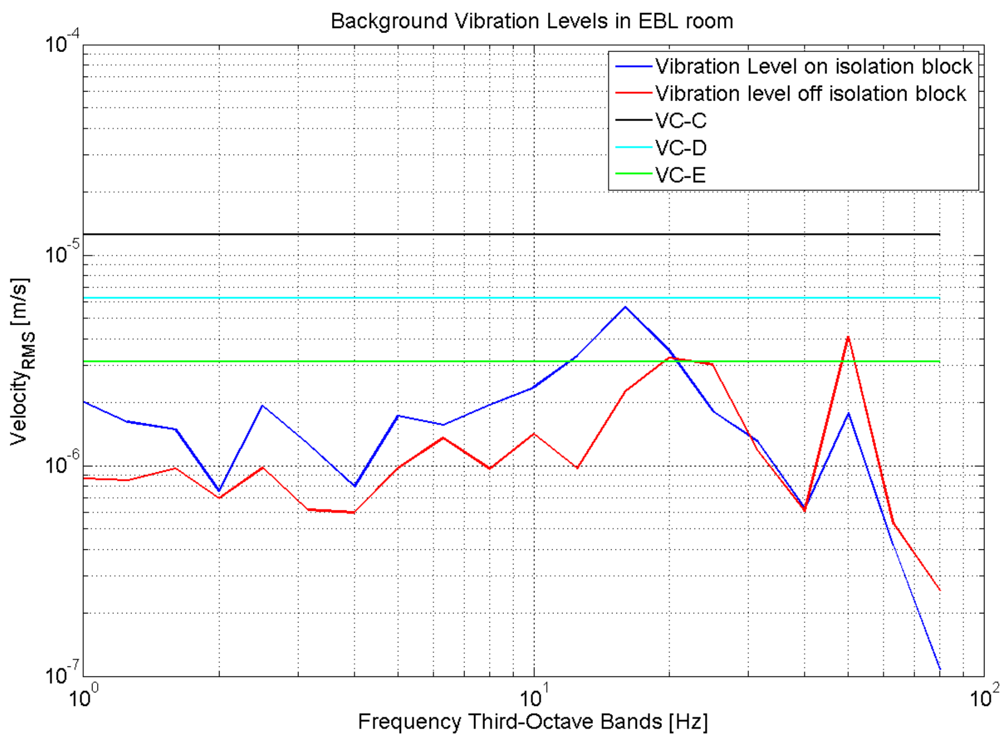

Figure 5.8 – Short term background vibration levels measured at EBL machine in the Nanoscience Centre. More isolation takes effect above 30Hz.

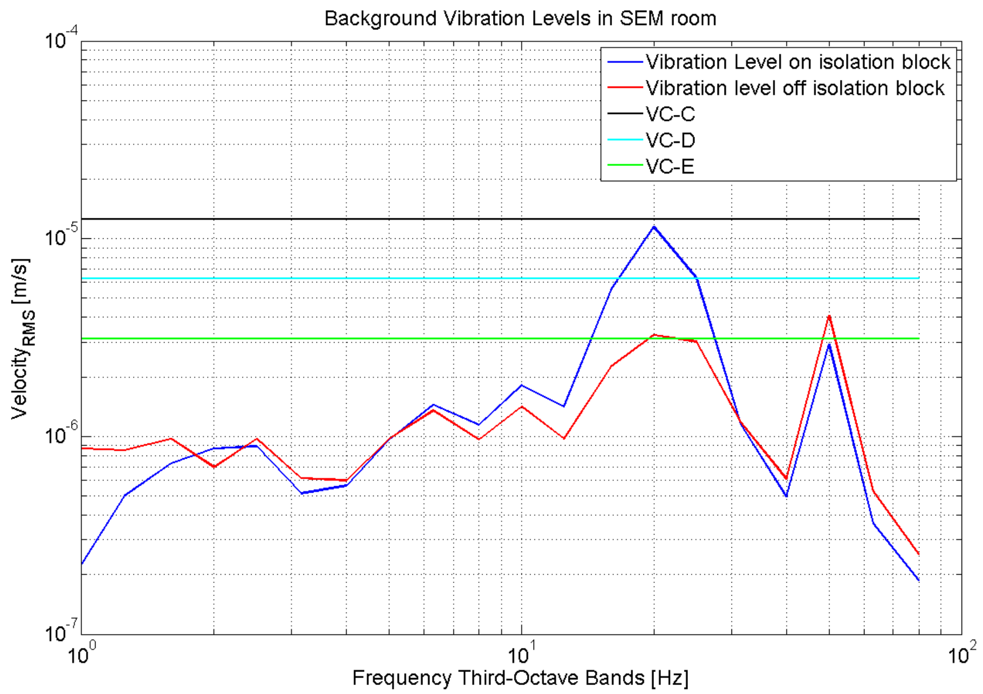

Figure 5.9 – Short term background vibration levels measured at SEM machine in the Nanoscience Centre. More isolation takes effect above 30Hz.

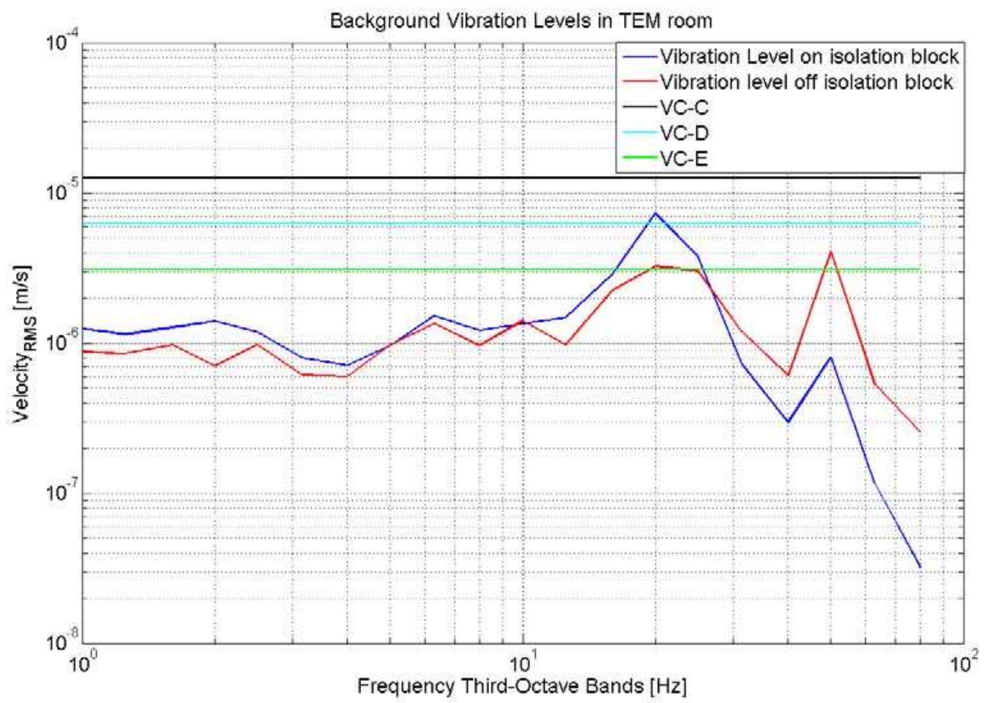

Figure 5.10 – Short term background vibration levels measured at TEM machine in the Nanoscience Centre. More isolation takes effect above 30Hz.

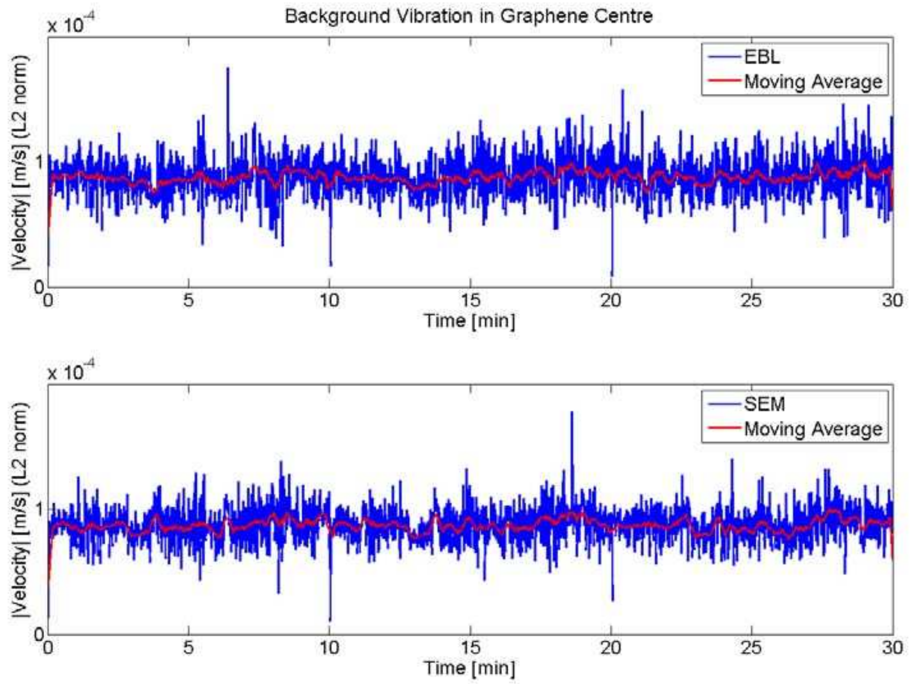

Figure 5.11 – Time trace of background velocity frequency module in the Graphene Centre. It is calculated as the square root of the velocity energy of each FFT spectrum. The red line is a 10 points moving average with each point representing a time window (Hanning) of 1.6s with 50% overlap.

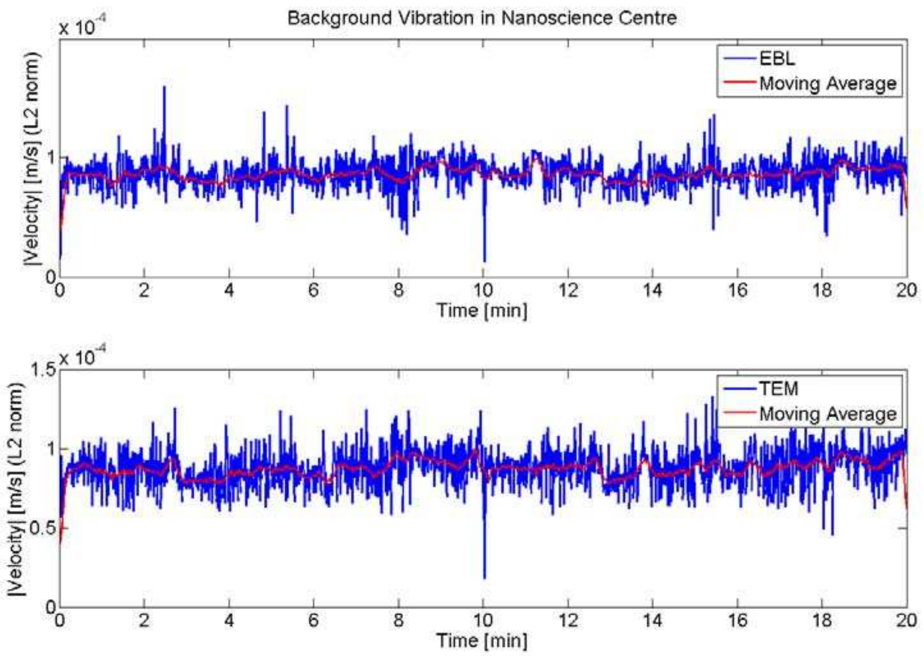

Figure 5.12 - Time trace of background velocity frequency module at EBL and TEM (module 1) in the Nanoscience Centre. It is calculated as the square root of the velocity energy of each FFT spectrum. The red line is a 10 points moving average with each point representing a time window (Hanning) of 1.6s with 50% overlap.

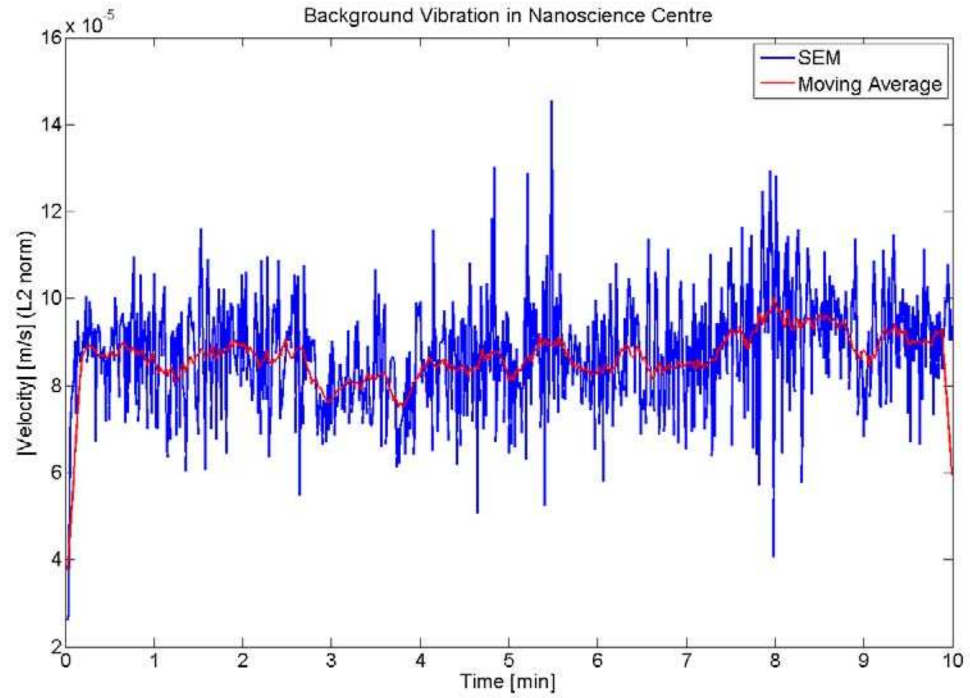

Figure 5.13 – Time trace of background velocity frequency module at SEM in the Nanoscience Centre. It is calculated as the square root of the velocity energy of each FFT spectrum. The red line is a 10 points moving average with each point representing a time window (Hanning) of 1.6s with 50% overlap.

6 THE IMPACT SOURCE

6.1 An impact source was developed to approximate the energy impulse on the ground of the activities in the future structures lab at West Cambridge. An impulsive source provides signal over a wide frequency range [3], from which transmission of ground-borne vibration can be predicted for other sources with specific frequency characteristics.

6.2 The site for the impact source test was located on the existing car park to the rear of the Graphene Centre approximately 30m from the face of the Graphene Centre. The location was chosen to represent the proposed location of the structures lab in the new building. The presence of buried surface water attenuation tanks (single size aggregate engineered fill) meant that the impact source location was located at the southern extreme of the proposed structures lab.

6.3 In Figure 6.2 the position of the impact source equipment is marked on aerial photo.

6.4 A concrete block 1m x 1m x 1m was cast on the ground to approximate coupling of activity into the ground . A 1m deep pit was excavated and the block cast onto the clay base layer, with no soil contact to the side of the block.

6.5 A 200kg cylindrical steel weight was lifted with a drilling rig and dropped onto the concrete block from different heights ranging from 50mm to 800mm. The diesel motor of the lifting rig was shut down during the drop to avoid imparting vibration.

6.6 In order to bias the vibration spectrum toward low frequencies and to protect the concrete against significant deterioration over multiple drops, neoprene mats of varying thicknesses 6mm to 24mm were placed on top of the slab.

6.7 Preliminary trials with mat thicknesses of 6, 12, 18, 24mm over the different drop heights indicated that the 24mm mat would create sufficient energy up to 80 Hz, the limit of the defined VC criteria. Data are presented here for the source with 24mm pad. Some additional measurements were made with thinner pads and no pads.

6.8 The impulse source energy at the top of the block is calculated from the potential energy $PE = m g h$. The energy imparted by the block into the ground is modified by the slab-ground interface.

Mass (kg)	200
Drop Height (mm)	Energy (Joules)
50	98
100	196
200	392
400	784
800	1,568

Table 6.1 – Potential Energy values for different drop tests.

6.9 The 98 Joule impact source is expected to represent a daily activity within the structures lab, for example gantry crane operation which levels have been measured in [2]. The two processes can be compared in terms of frequency content of the excitation produced or in terms of impact energy.

6.10 For the Gantry Crane movement, a maximum value of about 30 um/s is found in the range 4 - 5 Hz. A similar spectrum value is produced by the Glulam Split and Beam Casting Shaker (no load) but only in the low frequency range 3-7 Hz for the 98 and 196 Joule drop. Higher velocity values are found in the other frequencies of the field drop tests.

6.11 In terms of impact energy the 98 Joule drop represents a forklift driving over the construction joint. A 1000kg load was taken as example and 1cm height of drops.

6.12 The 1,568 Joule impact source is expected to represent the worst case scenario when the full loaded crane accidentally drops a 2000kg weight from a 100mm height. A similar energy can be produced by dropping a 200kg weight from 800mm.

6.13 The remaining cases were calculated to have a drop progression and address possible minor rare events.

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Figure 6.1 – Impact test equipment.

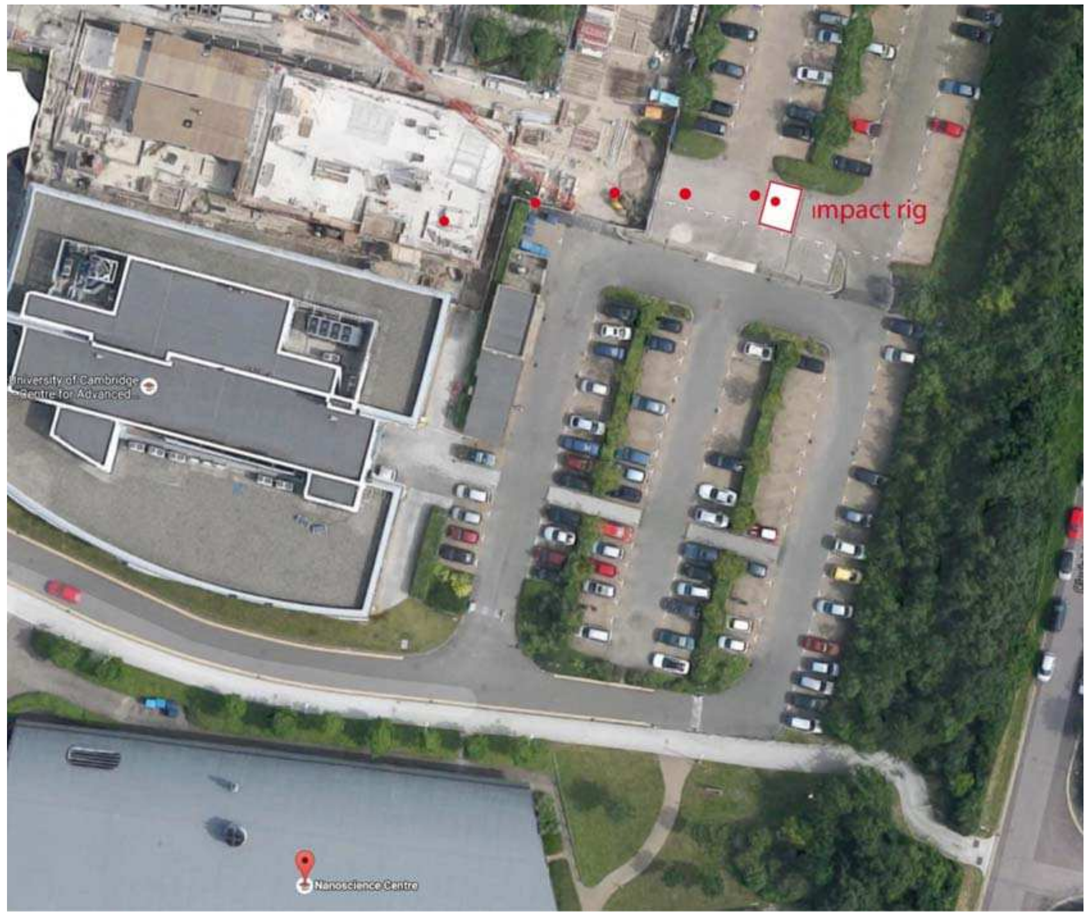

Figure 6.2 – Impact test equipment mark-up of aerial photo.

7 IMPULSE MEASUREMENTS

7.1 The site was visited on 25/08/2016 and 26/08/2016 by Bob Essert and Fabrizio D'Amelio. Dr. James Talbot (Cambridge University Engineering Department) was on site with his measurement kit. In collaboration with Dr. James Talbot, measurements were made of impulses propagating through the ground to the adjacent buildings.

7.2 The site for the impact tests equipment was in the existing car park to the rear of the Graphene Centre. Traffic was kept away from the immediate area during the measurements, and in any case was very light. No measurement was made when there was vehicle movement visible within the immediate vicinity.

7.3 The weather was fine, temperature 20-25C.

7.4 The impulses have been generated with the system described in section 6. As can be seen in Table 7.5 to Table 7.7 , different drop heights were chosen for different tests to reproduce typical activities and extraordinary events in the proposed new site of the structures lab.

7.5 Unless stated otherwise, results are reported for drops using the 24mm neoprene mat. No double hits of the steel bar were evident, validating the choice of using neoprene mats to dampen the impact on the concrete block.

7.6 Three different measurement sessions were conducted throughout the two days. Tests and measurements to estimate the behaviour of vibration propagation in the ground were conducted on 25/08/2016. The same day, measurements at EBL, SEM, Electronics Lab in the Graphene Centre were made. On 26/08/2016, the measurement kit was installed at the Nanoscience Centre.

7.7 Vibration propagation tests were made using 5 number Dytran 3191A1 high sensitivity single axis accelerometers and 1 single axis low-sensitivity accelerometer. The low sensitivity accelerometer was positioned on the concrete block to capture the acceleration at the source. Sensitivity of accelerometers is showed in Table 7.2. Dytran accelerometers A1, A2, A3, A4 were set on bespoke 3-point mounting plates on the tarmac ground at various distances from the source. Distances of the sensors from the source are showed in Table 7.1.

7.8 Measurements at the Graphene Centre were made using 3 Dytran 3191A1 single axis accelerometer set on their 3-point mounting plates on the floor next to the mountings of the sensitive equipment. Positions of sensors in the building are showed in Figure 7.1 and Table 7.3.

7.9 Measurements at the Nanoscience Centre were made using 4 Dytran 3191A1 single axis accelerometers set on their 3-point mounting plates on the floor. The structural isolation systems used in the Nanoscience Centre differ from the ones used in the Graphene Centre, and consists of a concrete block isolated from the main concrete slab of the building. Therefore, it was possible to measure the vibration levels on and off the isolation block to estimate the level of isolation achieved by the system. The positions of sensors in the building are showed in Figure 7.2 and in Table 7.4.

7.10 A National Instruments cDAQ model 9184 and laptop computer were used to acquire signals from the 6 accelerometers.

7.11 Sampling frequency was set to 2048 Hz, giving a max measurable signal frequency of 1024 Hz.

7.12 Duration of the measured impulse was between 0.5 to 1s depending on distance. A time window of 2s was used to extract the impulsive signal from each channel of the recording.

7.13 Unless stated otherwise, frequency analysis has been done in third-octave bands from 1 to 80 Hz, in line with the threshold specifications given in [1].

7.14 RMS velocity at each 1/3 octave band was calculated over the 2-second duration of the measurement.

7.15 A complete list of drop tests and measurements is showed in Table 7.5 to 7.7 for each measurement session.

Sensor	Distance from source [m]
A1	2
A2	10
A3	18
A4	32
A5	SEM Lab
Source	On concrete block

Table 7.1 – Positions of accelerometers from impact source.

Model:	Dytran	3191A1
Serial Number	Sensitivity	Unit
A1	10082	mV/g
A2	9958.9	mV/g
A3	9919.8	mV/g
A4	9859.7	mV/g
A5	10119	mV/g
Source	100.8	mV/g

Table 7.2 – Sensitivity of accelerometers

Sensor	Room
A1	EBL
A2	Electronics Lab
A5	SEM

Table 7.3 – Position of accelerometers in the Graphene Centre.

Sensor	Room
A1	SEM (on isolation block)
A2	SEM (outside isolation block)
A3	TEM - Module 1 (on isolation block)
A4	EBL (on isolation block)

Table 7.4 – Positions of accelerometers in the Nanoscience Centre.

File	Drop Height [mm]	Neoprene pad thickness [mm]
UKCRIC4	50	24
UKCRIC5	50	24
UKCRIC6	50	24
UKCRIC7	100	24
UKCRIC8	100	24
UKCRIC9	100	24
UKCRIC10	200	24
UKCRIC11	200	24
UKCRIC12	200	24
UKCRIC13	200	24
UKCRIC14	200	24
UKCRIC15	200	24
UKCRIC16	800	24
UKCRIC17	800	24
UKCRIC18	800	24
UKCRIC19	50	6
UKCRIC20	50	0

Table 7.5 – Measurements of vibration propagation in the ground.

File	Drop Height [mm]	Neoprene pad thickness [mm]
UKCRIC21	50	0
UKCRIC22	50	0
UKCRIC23	50	6
UKCRIC24	50	24
UKCRIC25	100	24
UKCRIC26	200	24
UKCRIC27	400	24
UKCRIC28	800	24

Table 7.6 – Measurements of vibration levels in the Graphene Centre.

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File	Drop Height [mm]	Neoprene pad thickness [mm]
UKCRIC29	0	0
UKCRIC30	50	0
UKCRIC31	50	6
UKCRIC32	50	24
UKCRIC33	100	24
UKCRIC34	200	24
UKCRIC35	400	24
UKCRIC36	800	24
UKCRIC37	50	0
UKCRIC38	100	0
UKCRIC39	200	0
UKCRIC40	400	0
UKCRIC41	800	0

Table 7.7 – Measurements of vibration levels in the Nanoscience Centre

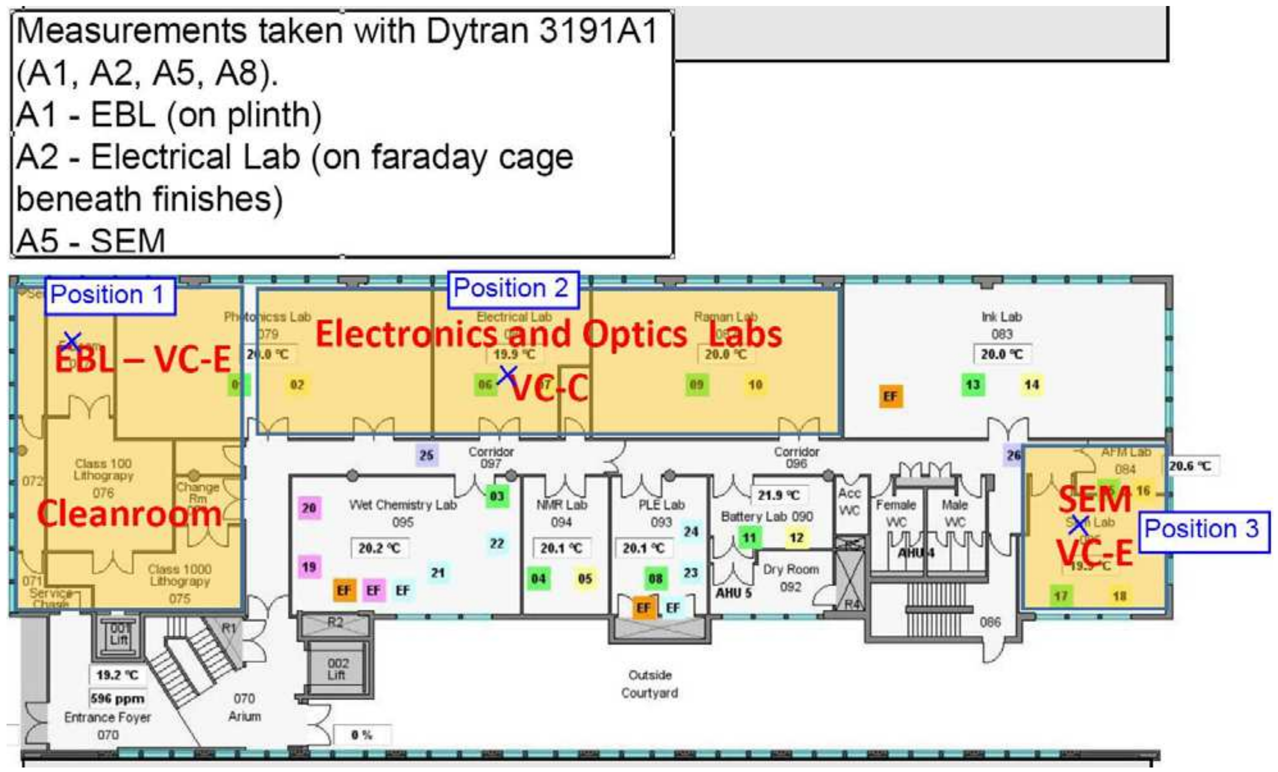

Figure 7.1 – Mark-up of measurement positions in Graphene Centre plan.

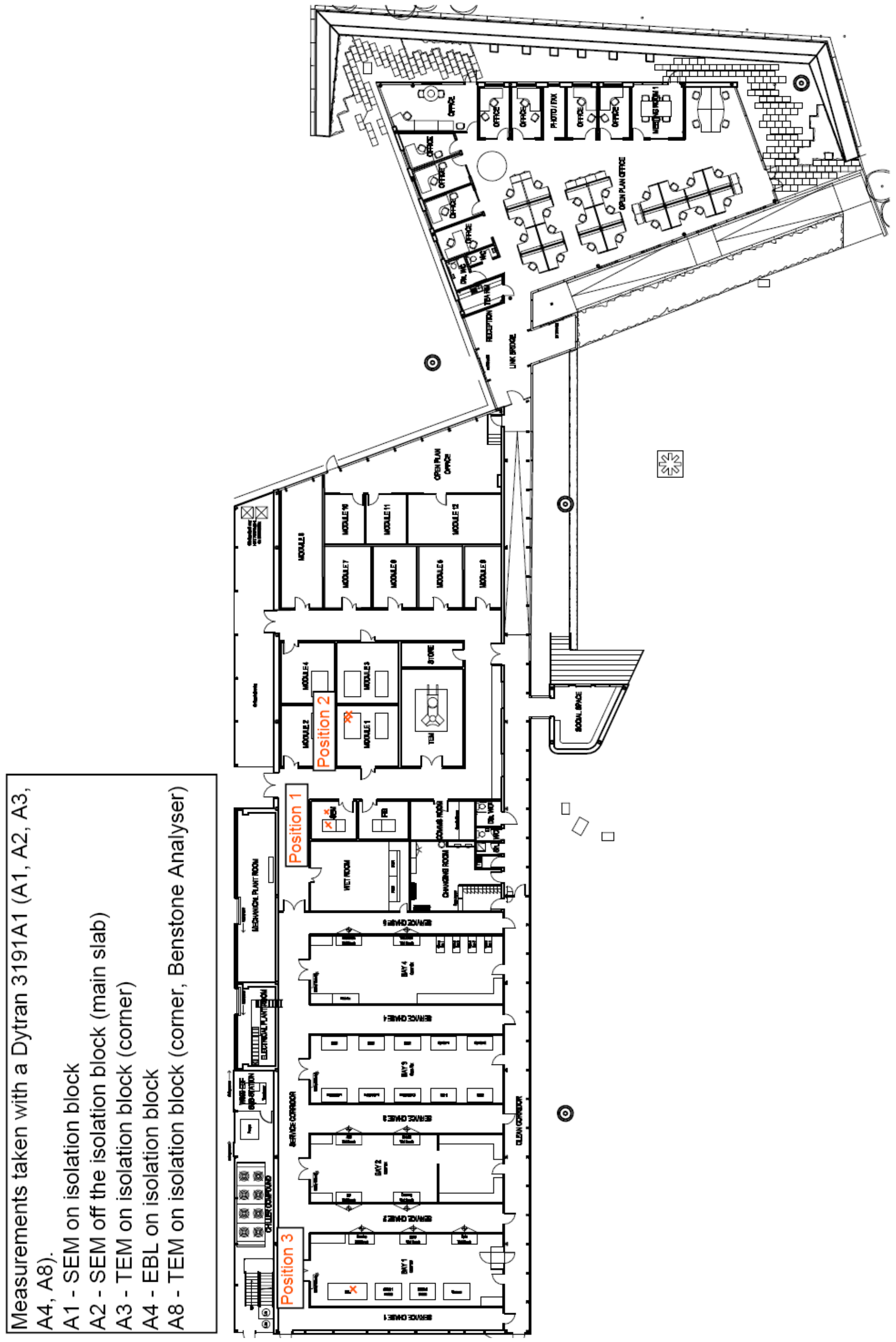

Figure 7.2 – Mark-up of measurement positions in the Nanoscience Centre plan.

8 OBSERVED DISTURBANCE AT MACHINE

8.1 An additional set of tests was carried out on 26/07/2016 in the Graphene Centre as well as in the Nanoscience Centre. The purpose of this set of drop tests was to test empirically if any disturbance could be noticed from the operator during normal use of the machines.

8.2 The machines used for these tests were the SEM in the Graphene Centre and the TEM in the Nanoscience Centre. The SEM machine in the Graphene Centre was operated by the lab manager Dr. Flavia Tomarchio.

8.3 In Table 8.1 and 8.2 tests parameters and notes of the results are presented.

Drop Height [mm]	Thickness of Neoprene pads [mm]	Observation at SEM	Comment
50	0	No detection	-
100	24	Minor detection	SEM operator stated that a minor disturbance was just visible but it was probably not correlated with the weight drop since happened seconds later the drop. The operator stated that the interference would not impact the operation of the machine.
200	24	No detection	-
400	24	No detection	-
800	24	Minor detection	A minor disturbance was just visible but it was probably not correlated with the weight drop since happened seconds later the drop. The operator stated that the interference would not affect the operation of the machine.

Table 8.1 – Drop tests with SEM machine in operation in the Graphene Centre.

Drop Height [mm]	Thickness of Neoprene pads [mm]	Observation at TEM	Comment
50	0	No interference	-
100	0	No interference	-
200	0	No interference	-
400	0	No interference	-
800	0	No interference	-

Table 8.2 – Drop tests with TEM machine in operation in the Nanoscience Centre.

9 RESULTS

9.1 The results of the measurements taken during the three sessions will be shown in this section starting from the vibration propagation measurements and then following with the Graphene Centre data and the Nanoscience Centre.

9.2 For each measurement three main parameters are considered, drop height and its relative impact energy, thickness of neoprene mats and distance from the impact source. In order to have a better view on the relationships between these parameters and the velocity values, plots over frequency and distance are presented in this section.

9.3 Figure 9.2 shows the spectrum of the impulsive vibration signal produced by dropping the 200kg steel bar on a concrete block from different heights with 24mm neoprene pad. RMS velocity over frequency in third-octave bands is shown. The distance of the accelerometer considered in this case is 10m from the impact source.

Attenuation with distance

9.4 Figure 9.3 shows the attenuation of vibration propagation in the ground. The accelerometers were placed as in Table 7.1. The results are plotted for the 50mm drop and 200mm drop to illustrate the propagation dependency on impact energy. There is little dependence on the initial energy.

9.5 Figure 9.4 characterizes the attenuation in frequency with respect to distance from the impact source.

9.6 Figure 9.5 shows the calculated transfer function of the soil on which the concrete block rests. The results are presented at different distances from the impact source. The propagation behaviour is dependent on distance and soil homogeneity. The frequency range showed is clipped at 250 Hz since the signal to noise ratio was deemed too low at higher frequencies.

Graphene Centre

9.7 The data obtained at the Graphene Centre are presented in three different figures, one for each machine. RMS velocity is plotted in third-octave frequency bands. VC criteria are also shown.

9.8 Figure 9.6 shows the levels obtained in the EBL room. The accelerometer was placed on the concrete plinth that will support the machine. The concrete plinth is cast monolithic with the main building raft foundation.

9.9 Figure 9.7 shows the vibration levels obtained in the Electronics Lab for different weight drops. The accelerometer was placed with floor finish cut outs and as such assumed to be placed on the concrete raft slab although this could not be confirmed on site (details of the floating “Faraday” floor were not clear).

9.10 Figure 9.8 shows the vibration levels obtained in the SEM room for different weight drops. The accelerometer was place on the floor finish which was a lino floor assumed to be bonded to a concrete screed finish. The relationship between floor finish and the underlying concrete raft foundation is not known.

Nanoscience Centre

9.11 Vibration levels have been similarly measured in the Nanoscience Centre. The measured rooms are EBL (Bay 1), SEM and Module 1 which will house a TEM machine. Only the 400mm and 800mm drop tests were measurable since the signal to noise ratio was deemed too low for lower impact energies.

9.12 Figure 9.9 shows the vibration levels obtained in the EBL room. The accelerometer was placed on the floor finish and on the isolation block.

9.13 Figure 9.10 shows the vibration levels obtained in the SEM room. The accelerometer was placed on the floor finish and on the isolation block.

9.14 Figure 9.11 shows the vibration levels obtained in the TEM room (Module 1). The accelerometer was placed on the floor finish and on the isolation block.

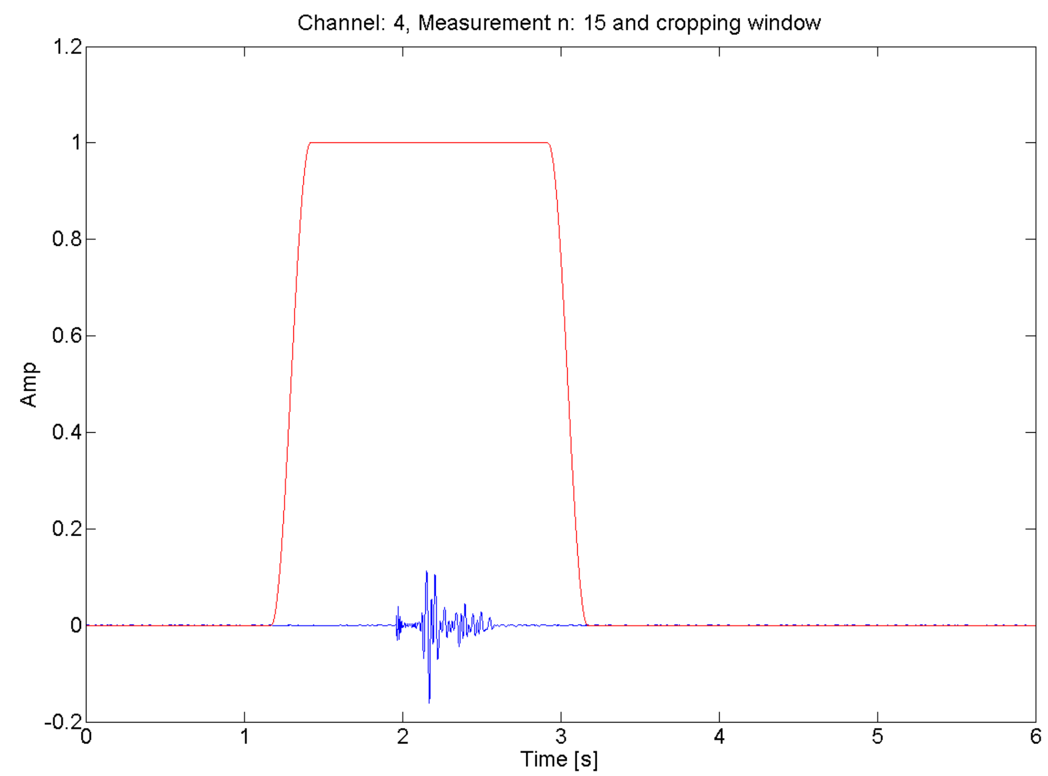

Figure 9.1 – An example of acceleration signal captured at one sensor (32m) cropped in time with a 2s Tukey (raised cosine) window around the impulse. Measurement number 15 is a 800mm drop test with 24mm thickness of neoprene pad.

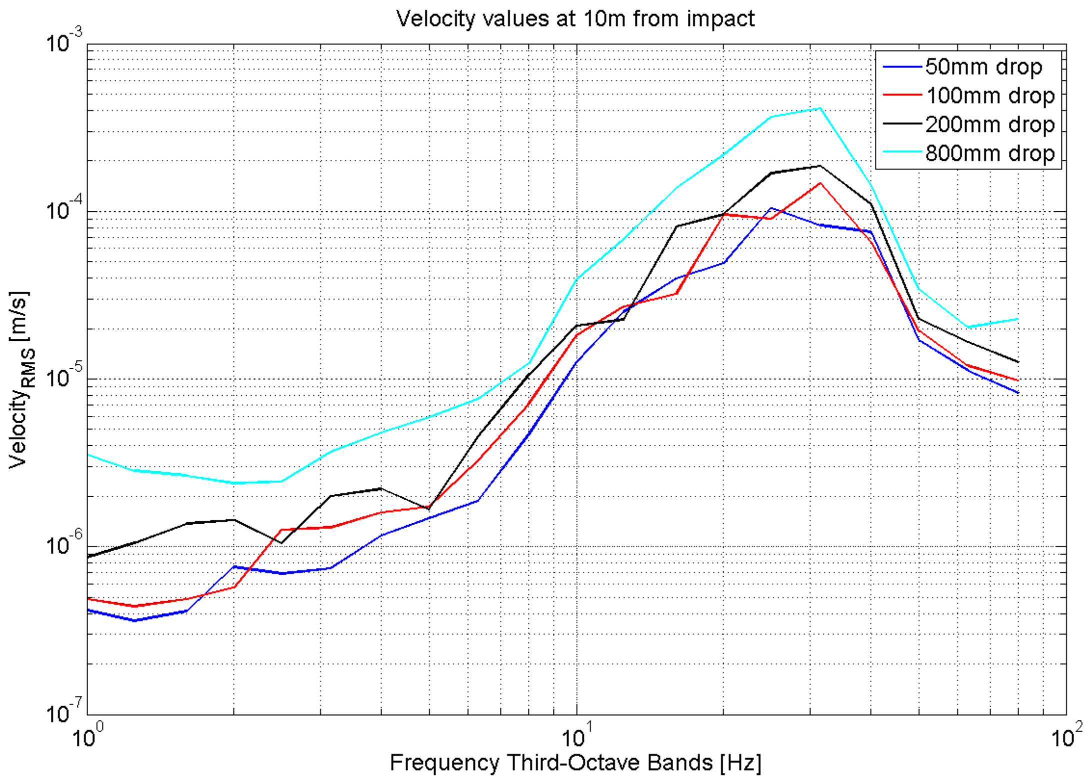

Figure 9.2 – RMS Velocity over frequency in third-octave bands measured at 10 m from the impact source. Different curves resulting from various drop heights are displayed over frequency. Neoprene thickness is 24 mm for all measurements.

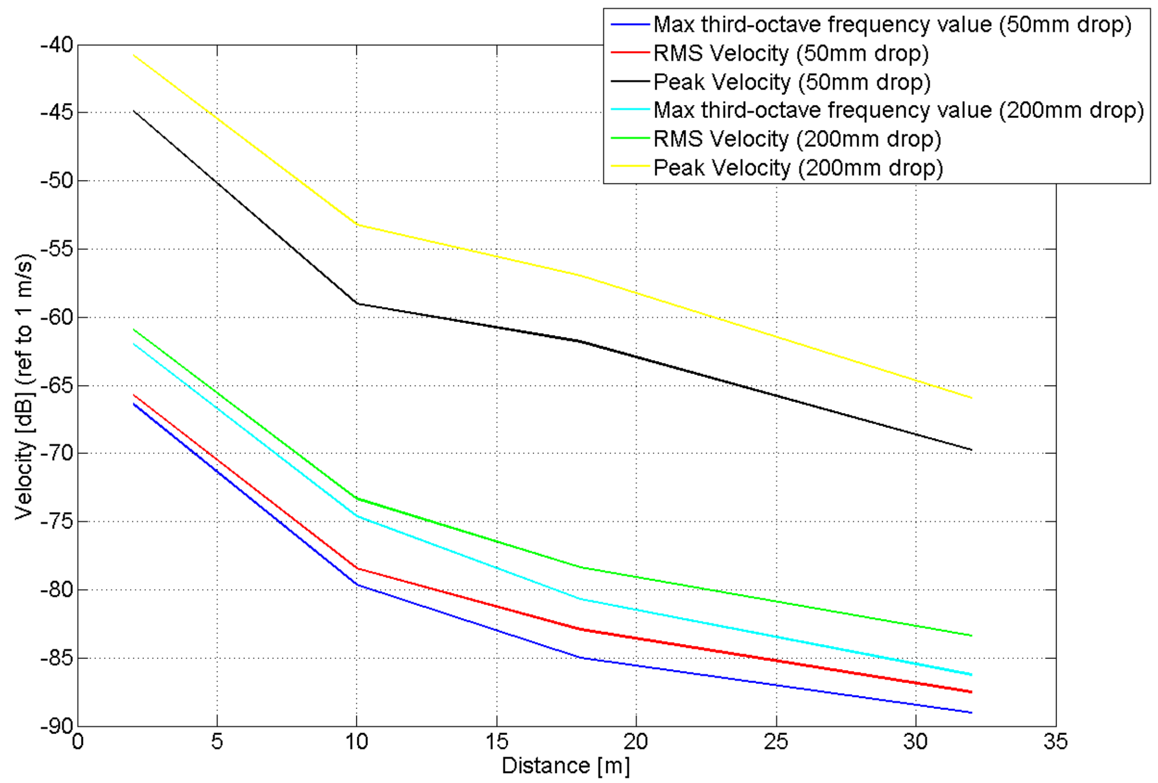

Figure 9.3 – Velocity in dB (ref to 1 m/s) over distance from impact source. The values are sampled at 2m, 10m, 18m, 32m. The curves showed are obtained by taking the max value of RMS velocity over the frequency range at each accelerometer, the peak value of the velocity signal in the time domain and the RMS velocity values in the time domain.

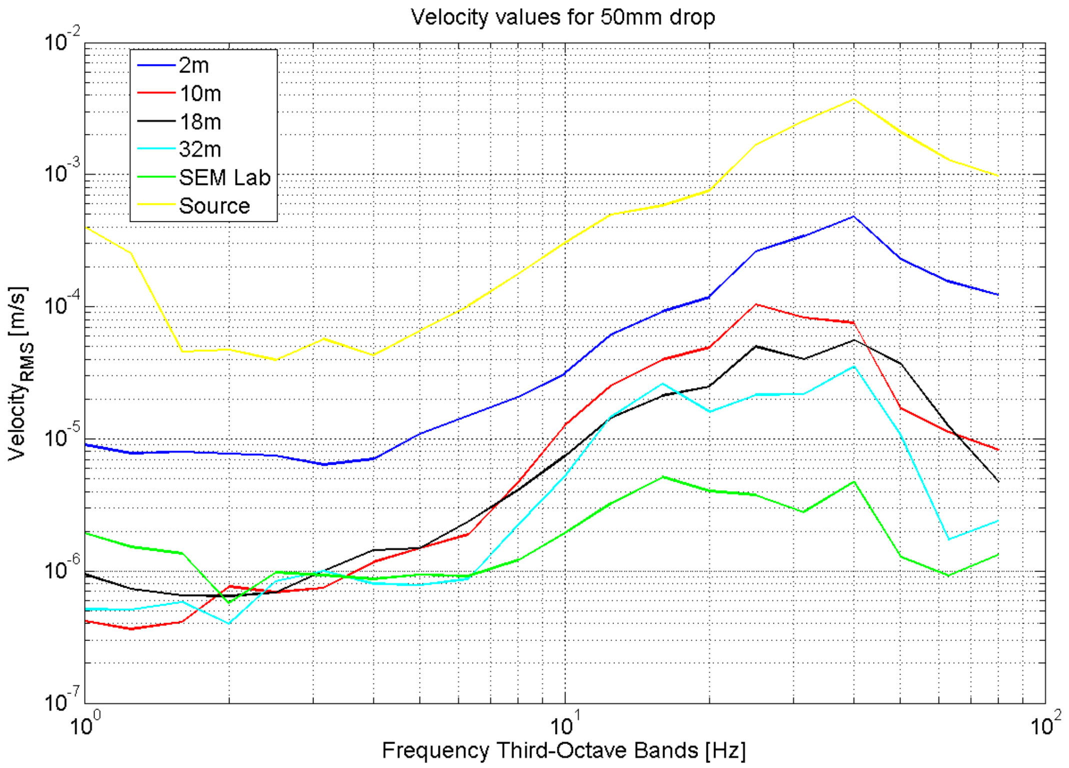

Figure 9.4 – RMS velocity in third-octave bands measured at several distances from the impact source.

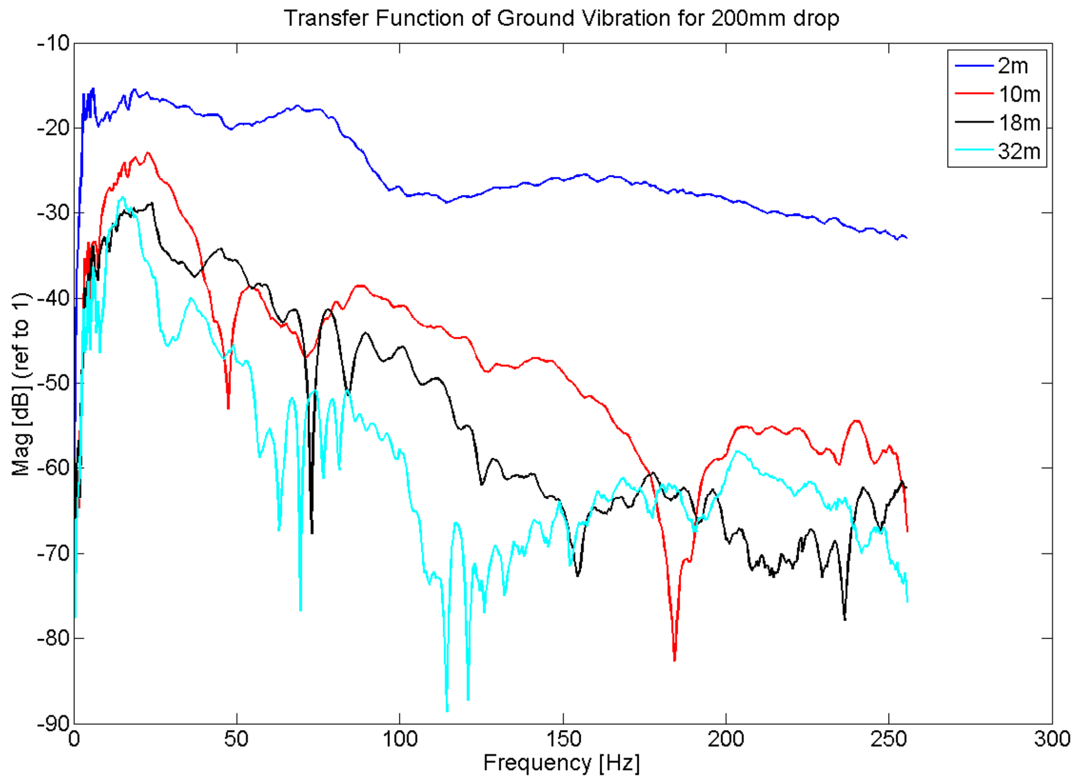

Figure 9.5 – Transfer function of soil at several distances from impact source calculated as $H_i(w) = Y_i(w)/X(w)$, where X(w) is the source signal (in frequency) measured on top of the concrete block and $Y_i(w)$ is the signal captured by one accelerometer placed at a certain distance from the source.

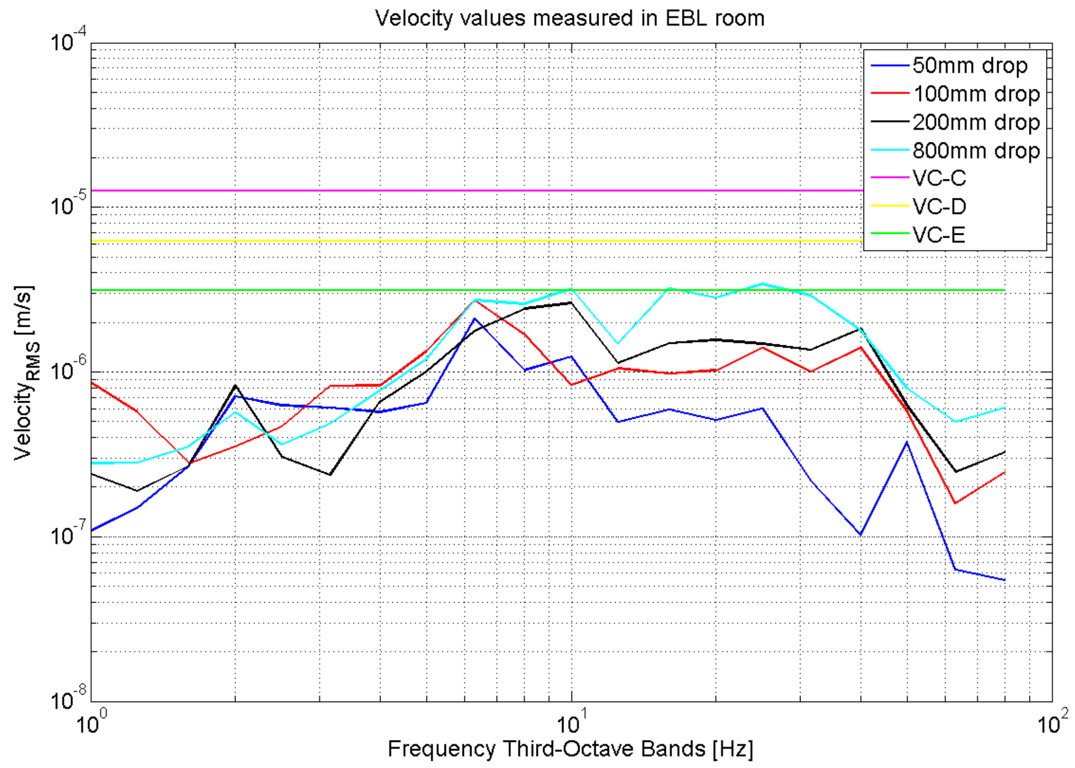

Figure 9.6 – Vibration levels measured on the plinth of the EBL room in the Graphene Centre.

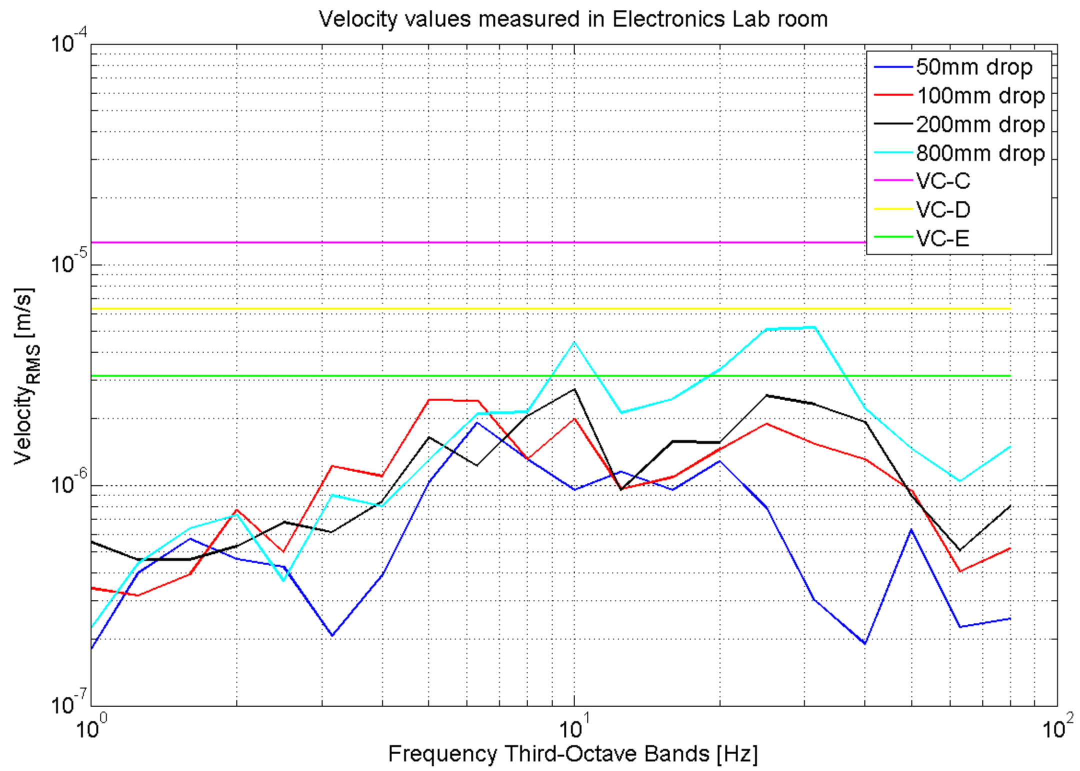

Figure 9.7 – Vibration levels measured in the Electronics Lab of the Graphene Centre.

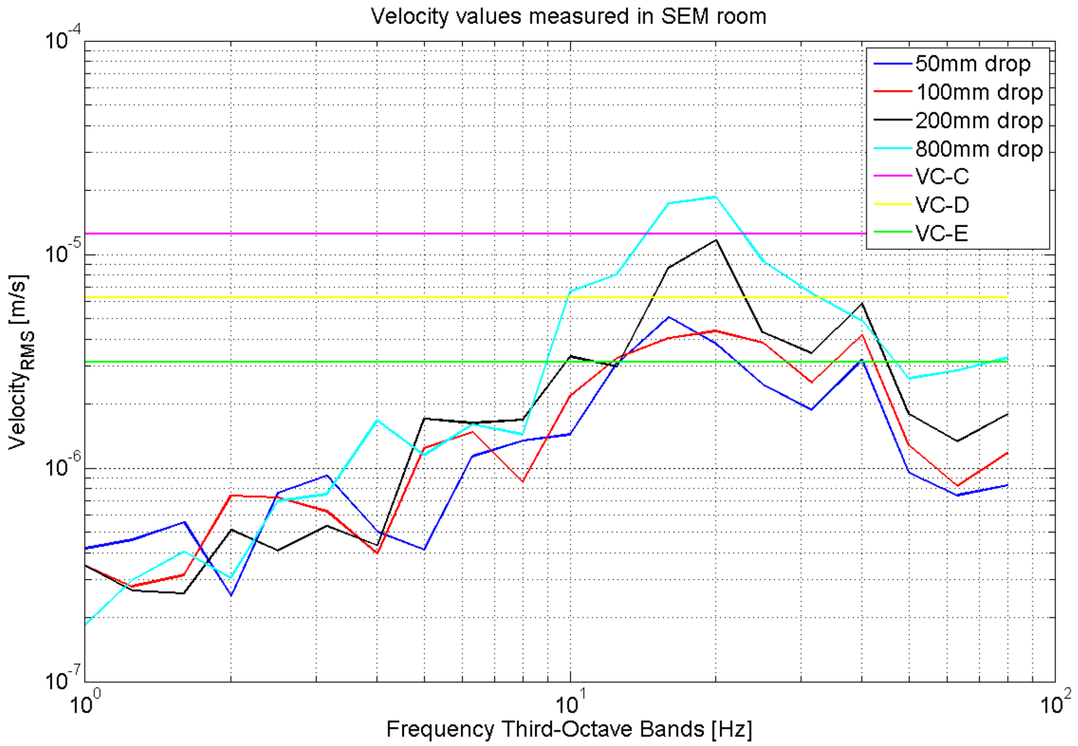

Figure 9.8 - Vibration levels measured in the SEM room of the Graphene Centre.

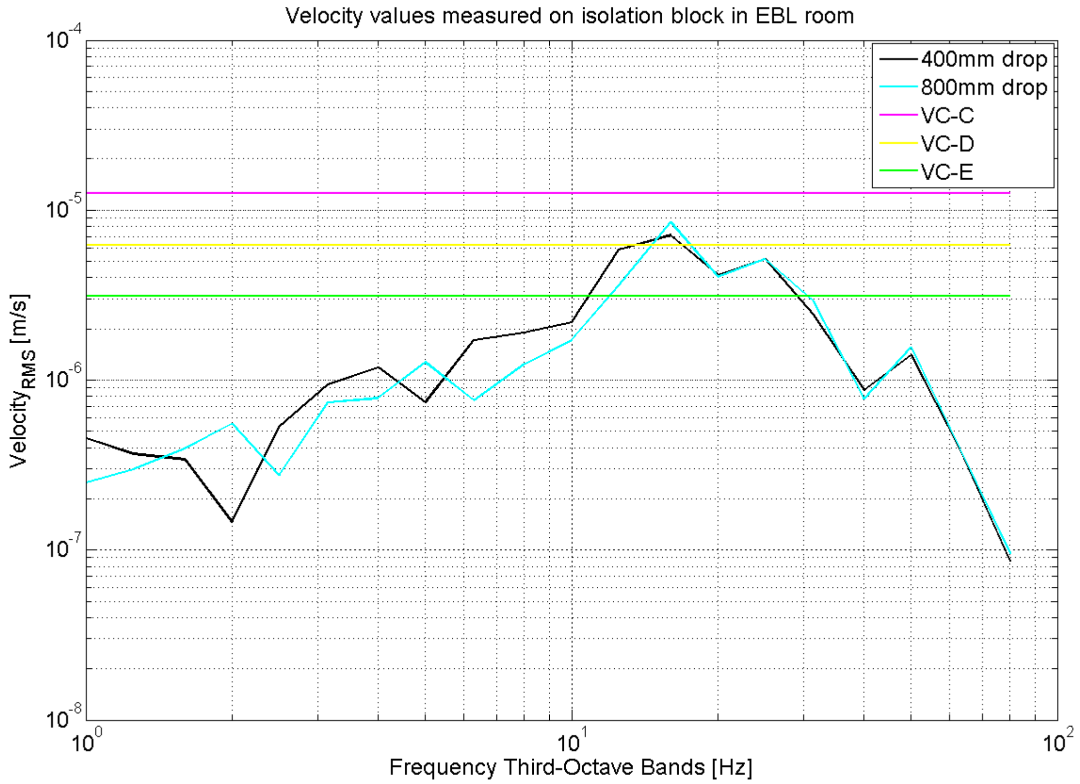

Figure 9.9 – Vibration levels measured in the EBL room of the Nanoscience Centre. The sensor was placed on the isolated concrete block. Impact source drops less than 400mm were not detected.

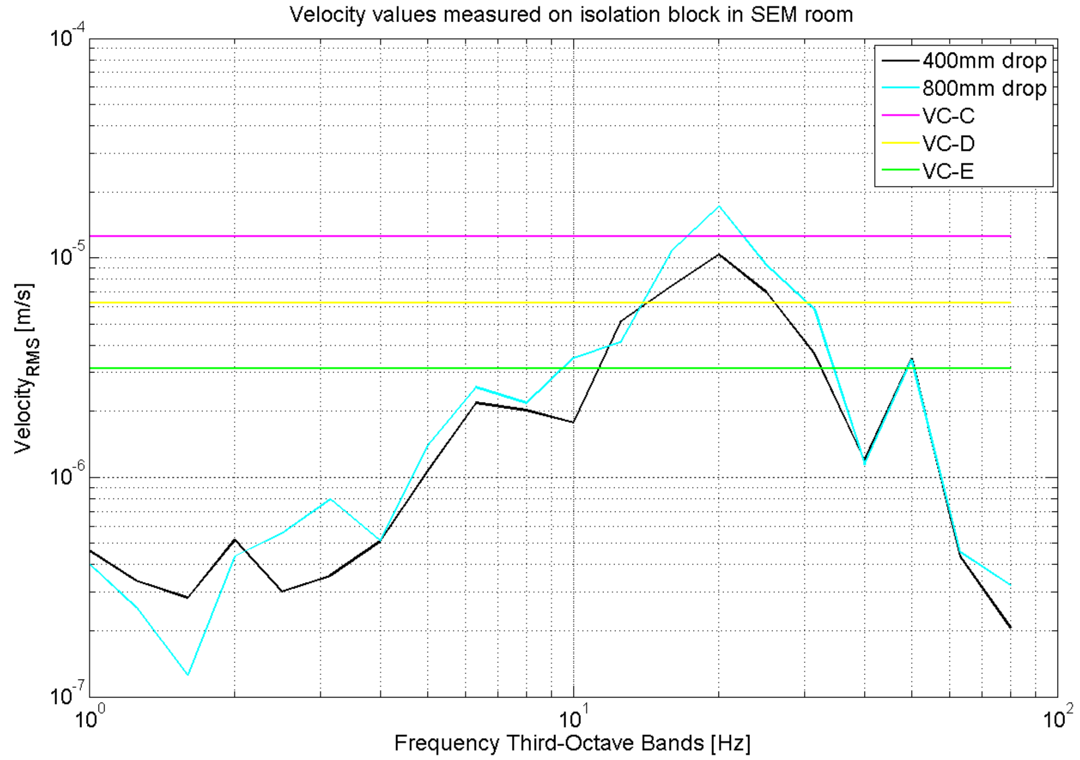

Figure 9.10 – Vibration levels measured in the SEM room of the Nanoscience Centre. The sensor was mounted on the isolation block of the machine. Impact source drops less than 400mm were not detected.

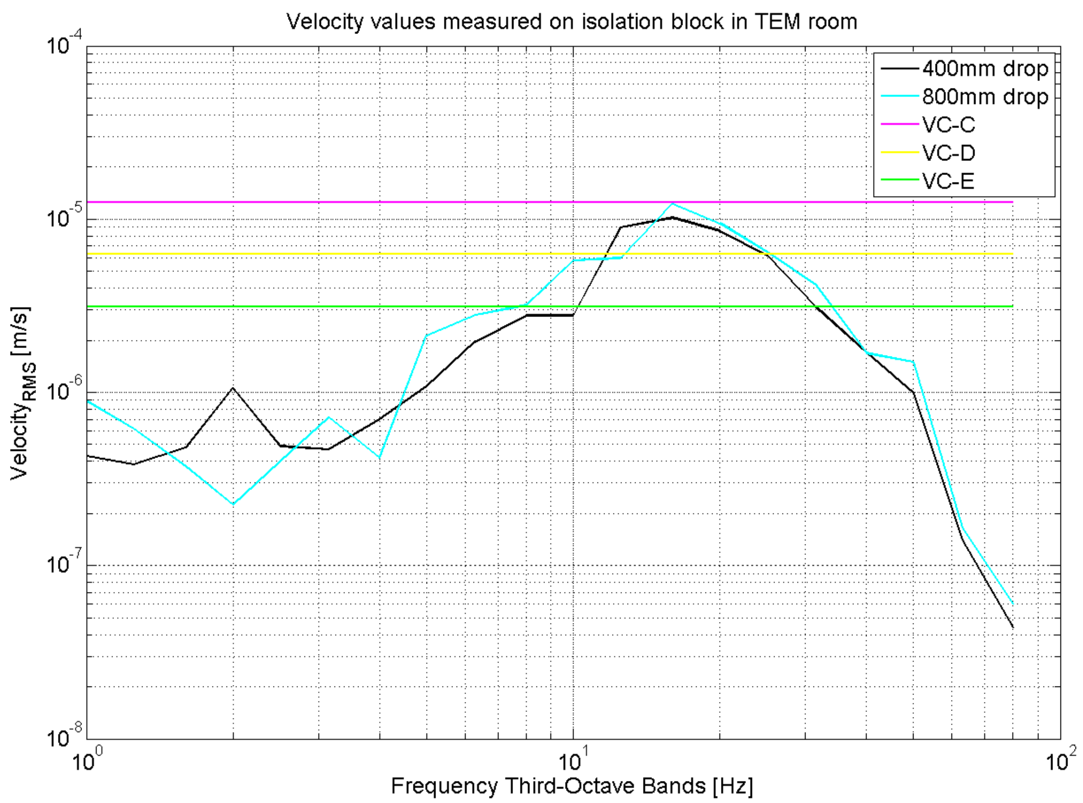

Figure 9.11 – Vibration levels measured in the TEM room (Module 1) of the Nanoscience Centre. The sensor was mounted on the isolation block of the machine. Impact source drops less than 400mm were not detected.

10 ANALYSIS

10.1 At the Graphene Centre, the most prominent frequencies measured at each drop test are found to be in the range 10 – 30 Hz. These frequencies are also the greatest in energy at the source, as it can be seen in Figure 9.4.

10.2 The 98 Joule source (50mm drop) is likely to occur several times a week in the concrete lab and even if it exceeds the VC-E threshold set out for the SEM machine, the internal isolation system that supports the machine appears to perform well enough to permit a normal use of the machine without major disturbances.

10.3 Impacts in the SEM room were above VC-E at 20 Hz for all input energies, and above VC-D for the upper 3 energies (which are unlikely to occur in the new building). Despite this, the operator of the SEM stated that the vibration impulses in the SEM room had no significant detrimental effect on the use of the machine, even at the highest energies.

10.4 The 98 Joule source (50mm drop) is attenuated enough as it propagates to the EBL and Electronic Labs to be below VC thresholds. Therefore, the machines installed in these two rooms with a vibration requirement of VC-E should not experience any disruptions given by vibration generated at the proposed new site of the Civil Engineering Building.

10.5 The structures lab of the Civil Engineering Building will be 30m by 60m and the strong floor will be on elastomeric pads. The concrete lab will sit on a floating reinforced concrete slab that sits on the raft. The final building is a dynamically complex system with different masses and dampening materials, and the real performance will depend on resonances at certain frequencies and complex propagation into the ground. The floor of the concrete lab will be a floating reinforced concrete slab supported on resilient bearings on the raft slab, and this will damp the vibration levels arriving at the building foundations. In addition, the new building will be coupled with the surrounding ground, resulting in an increased stiffness and damping by the ground itself. Also, vibration propagation in the ground will differ in attenuation with distance and directivity from the that of $1m^3$ concrete cube used in tests.

10.6 The impact tests were on balance conservative. The $1m^3$ concrete cube used in the tests models the foundations of the new Civil Engineering Building, but it does not include the isolation systems in effect before the building foundations.

10.7 The 196 Joule source (100mm drop) is likely to occur less often, probably once a month, since it can be related to the spectrum produced by the Glulam Split or a Beam Casting Shaker. The machine is not regularly used in the lab. It has to be noted that the frequency content of the two signals, drop test and Glulam Split/Beam Casting Shaker is different and lower in general but they could be compared in the range 4-8 Hz.

10.8 The 1,568 Joule source (800mm drop) is not likely to occur or just in rare events (probably once a year) like accidental weight drops from about 100mm of the loaded crane (2000kg).

10.9 Impacts in the Graphene Centre EBL room and Electronics Lab were below VC-E for all energies except the highest, which is unlikely ever to occur.

10.10 The Electronics Lab will be subjected to a major refurbishment in the future, Thus, the results shown in Figure 9.7 are only valid for the measured point. The surface on which the accelerometer is placed could influence the results due to resonances of the floor finishes.

10.11 The magnitude of the ground transfer function (Figure 9.5) is independent of the impulse energy (drop height), at least in this range. The plot shows how frequencies are attenuated differently as the vibration wave propagates further from the source. A 10 dB (ref. to 1) difference between 5 and 80 Hz is found at 2m from the source but a 15 dB difference is found at 32 meters in the same frequency range, indicating a greater attenuation with distance for higher frequencies. A decay rate of 5-6 dB per doubling distance is found at 5 Hz whereas a decay rate of 8-10 dB per doubling distance is found at 80 Hz.

10.12 For this source geometry, vibration velocity increases at 5 dB / doubling of input energy. Adjustments for larger slabs should be made during design.

10.13 Beyond 10m the overall vibration level falls off at about 6 dB per doubling of distance.

10.14 Impacts were not measurable in any of the Nanoscience building locations for impacts less than 784 Joules (400mm drop). In these cases, the impulsive signal given by the weight drop was not distinguishable from the background noise.

10.15 The long term average background noise in the measured positions in both Nanoscience Centre and Graphene Centre does not exceed the vibration criteria of the machines (Figure 5.3 to 5.6). Short term events found in the Nanoscience Centre (Figure 5.8 to 5.10) can exceed VC-

E in a narrow band around 20 Hz, which could be due to resonance of the resilient block support.

10.16 Given the significant short term background vibration in the Nanoscience Centre (in some cases above VC-E) and the fact that interference of drop tests with TEM machine was not detected, it is apparent that the specialist/internal isolation systems for the equipment play a significant role in achieving the successful working levels. We expect this will continue to be the case after the new building is completed and occupied.

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CAMBRIDGE UNIVERSITY ENGINEERING DEPARTMENT

Source Vibration Levels of Structures Lab Activities

Revision 1: 9th March 2016

Delivered by email to: Simon Smith, Smith & Wallwork Engineers
cc: Bob Essert, SSV

1 EXECUTIVE SUMMARY

1.1 This report has been prepared under instruction from Smith & Wallwork Engineers, and is intended to form part of a strategy for planning the relocation of the Structures Research lab and the Civil Engineering Group to a new building on the West Cambridge Site.

1.2 The proposed site options include plots close to the existing Centre for Advanced Photonics and Electronics, which houses the Cambridge Graphene Centre, as well as the Nanoscience Centre. Both the Graphene Centre and the Nanoscience Centre employ test and manufacturing equipment and processes that are sensitive to disturbance from vibration.

1.3 The current Structures Research Lab is located within the Department of Engineering building on Trumpington Street, Cambridge. A number of activities and equipment are in use that, when relocated to the new site, raise some concerns about vibration levels that may propagate to the neighbouring Cambridge Graphene Centre and/or the Nanoscience Centre.

1.4 The vibration survey was also carried out to provide source vibration level input for the design of the new UKCRIC building, in particular to inform (with Part 2 of the study):

- whether the vibration levels generated will impact on the new building design (in terms of building occupants).
- whether the vibration levels generated will impact on the new building design (in terms of vibration sensitive equipment in the new UKCRIC building).

1.5 This report presents data measure at the Department of Engineering for a selected range of activities. From this data, engineering design values for source vibration levels will be derived, for use in vibration propagation evaluations at later stages in the siting decisions and designs of the relocated laboratory.

1.6 This document must be read in conjunction with the associated set of A3 figures, showing measured data.

1.7 This version of the report is Revision 1. It replaces the original issued on 24 February 2016.

2 REFERENCE DOCUMENTS

2.1 STANDARDS

1. H. Amick, M. Gendreau, T. Busch, and C. Gordon, "Evolving criteria for research facilities: vibration," *Proceedings of SPIE Conference 5933: Buildings for Nanoscale Research and Beyond*, San Diego, CA, 31 Jul 2005 to 1 Aug 2005

2.2 A3 FIGURES

2. 2193-R01-F01: Calibration Check
3. 2193-R01-F02: Concrete Mixer – Data Overview
4. 2193-R01-F03: Concrete Mixer – Dry Load – Engineering Data Summary
5. 2193-R01-F04: Beam Casting Shaker - Data Overview
6. 2193-R01-F05: Beam Casting Shaker - Engineering Data Summary
7. 2193-R01-F06: Shaker Table - Mid Height - Data Overview
8. 2193-R01-F07: Shaker Table - Mid Height - Engineering Data Summary
9. 2193-R01-F08: Handheld Breaker - Data Overview
10. 2193-R01-F09: Handheld Breaker (Concrete) – Engineering Data Summary
11. 2193-R01-F10: Handheld Breaker (Steel) – Engineering Data Summary
12. 2193-R01-F11: Fork Lift Drop - Data Overview
13. 2193-R01-F12: Fork Lift Drop - Engineering Data Summary
14. 2193-R01-F13: Gantry Crane - Data Overview
15. 2193-R01-F14: Gantry Crane - Engineering Data Summary
16. 2193-R01-F15: Glulam Split - Data Overview
17. 2193-R01-F16: Glulam Split - Engineering Data Summary
18. 2193-R01-F17: Background Vibration Levels

3 INTRODUCTION

3.1 Through discussion with the Structures Lab Manager, the following types of activities associated with the Lab were identified as potential sources of vibration disturbance:

- Mixing and vibrating of concrete for casting of test samples
- Breaking of concrete samples using hand-held 'jack hammers' (sometimes referred to as 'Kango hammers')
- Dropping and moving of loads from fork-lift trucks
- Movements of the overhead gantry crane
- Dynamic load/cyclical load test rig
- Stress testing to breaking of structural beam samples

3.2 For each Category, a number of specific operation were identified for testing:

- Concrete Mixing
- Concrete Beam Casting – Vibrator (used to release air pockets before setting)
- Concrete Sample Casting – Shaker Table
- Handheld Breaker – breaking of concrete sample laid on floor
- Fork-lift Truck – drop-placement of load onto bearers
- Gantry Crane – vibration due to movements
- Beam splitting (stress testing to breaking) – impulse source at failure point.
- Note that the dynamic load/cyclical load test rig was not able to be operated on the day of the tests.

4 SURVEY METHOD

4.1 The Lab was visited on 3 February 2016 by Bob Essert, Evan Green and Paul Malpas of Sound Space Vision.

4.2 Tests were made using a 356B18 PCB tri-axial accelerometer (Serial No. 07241002) and Benstone Impaq Elite, 4 channel dynamic signal analyser.

4.3 Unless stated otherwise, the accelerometer was fixed to the floor, with Channel 3 (Z Axis) oriented vertically (ie in the 'foot-head' mode). In general, the Channel 1 (X Axis) was orientated towards the equipment under test, and might be thought of as the 'Front-Back' mode. Channel 2 (Y Axis) may then be thought of as the 'Left-Right' mode.

4.4 A Rion VE-10 accelerometer calibration check source was used to confirm the sensitivity settings of the test equipment. See the A3 figure in Reference 2.

4.5 Tests were made of activities and test cases (conditions) as listed in Table 1. In each case, time trace data was recorded in each of the X, Y and Z axes simultaneously, of RMS vibration velocity, using a sample period of 0.4s and frequency resolution of 2.5Hz.

File	Time	Activity/ Equipment	Test location	Case/ Condition	Anticipated Usage
calib	10:00	Calibration		10mm/s rms	
Mixing1	10:14	Concrete Mixer	100mm from base plate edge.	Dry	Concrete lab (mixing, shaking) used approx.. once per fortnight. Mixing run up to 5 mins per batch
Mixing2	10:15	Concrete Mixer	100mm from base plate edge.	Dry	
Mixing3	10:16	Concrete Mixer	100mm from base plate edge.	Added water	
CastingEmpty	10:21	Beam Vibrator	100mm from foot edge at motor end, on same slab	Empty	Casting or table shaker runs for up to 1 minute, twice per sample
Casting1	10:24	Beam Vibrator	100mm from foot edge at motor end, on same slab	Half full	
Casting2	10:34	Beam Vibrator	100mm from foot edge at motor end, on same slab	Full	
ShakingEmpty	10:39	Shaker Table - mid height	100mm from base plate edge.	Empty	
Shaker1	10:41	Shaker Table - mid height	100mm from base plate edge.	Half full	
Shaker2	10:45	Shaker Table - mid height	100mm from base plate edge.	Full	
Kango1	11:13	Kango hammer	250mm from concrete beam rested on floor of structures lab	Concrete beam	Breaking tool used as required to dispose of samples. Perhaps 2-3 times per year, per periods up to 1 hour each
Kango2	11:14	Kango hammer	250mm from concrete beam rested on floor of structures lab	Concrete beam	
Kango-Steel	11:15	Kango hammer	500mm from steel plate rested on floor of structures lab	onto 10mm steel plate	
Fork1	11:48	Fork Lift drop 1	500mm from bearers	example 1	Fork lift movements may be regular – eg once per month. However, 'drop' events may be les regular, and each drop represents a vibration event of less than 1 second
Fork2	11:48	Fork Lift drop 2	500mm from bearers	example 2	
Fork3	11:53	Fork Lift drop 3	500mm from bearers	example 3	
Gantry3	12:15	Gantry crane	Floor at mezzanine	Crane to mezzanine floor	Gantry crane used whenever needed. However, most running induces levels only close to background, with occasional low level peaks above that
0005(1)	14:57	Glulam splitting tests 2	100mm from beam support	Sample breaks	This is a very infrequent activity. In any case, the actual vibration event occurs only at the point of failure, for less than 1s.

Table 1: Vibration Source - Activities and conditions/cases tested

5 ANALYSIS

5.1 The vibration record files were analysed using the Benstone Novian software, v2.1.8.1, supplied on the website (www.benstone.com).

5.2 Analysis was made for each of the Activities listed in Table 1.

5.3 For each Activity, the files for each relevant case were opened and examined for each axis (X, Y, Z) individually.

5.4 Except where stated otherwise, each measurement record uses a 2.5Hz frequency resolution and 400 lines FFT, resulting in 0.4s sample lengths and analysis up to 1000Hz.

5.5 In the associated A3 figures, for each Activity, two types of Results sheets are presented:

- Data Overview
- Engineering Data Summary

5.6 For each case and axis, the time traces were viewed as intensity maps, for example as seen in 2193-R01-F01 (Reference 2). In the intensity map, frequency bins are shown across the graph x-axis, with time (or sample count) progressing up the graph y-axis. Colour intensity forms the graph data or z-axis, allowing the event to be viewed in a time and frequency spectrogram.

5.7 'Waterfall' 3 dimension plots (not typically shown here) were also used to help identify the character and timing of any trends, transients or events within each recording analysed.

5.8 Through inspection, it was established if mode (X, Y, Z), case or both were critical elements in identifying the dominant characteristic(s) of the measured activity. Where helpful, 'slices' of the intensity maps were extracted as either a spectrum for a particular sample count/time, or a time slice for a particular frequency bin. These were used as visual indications of the character and timing of each activity measured, such as comparing the trends between the modes (X, Y, Z) and the cases investigated.

5.9 The 'Data Overview' sheets record the intensity map spectrograms (time/frequency, colour as amplitude), along with any helpful spectral or time slices, as well as essential observations, which are expanded on in the sections below.

5.10 During the analysis, the FFT frequency bin data were combined and distributed between the relevant One Third Octave frequency bands from 2.5Hz to 1000Hz. The 'Engineering Data Summary' sheets then record two graphs of third octave vibration level (rms):

- RMS velocity amplitude, averaged over typical running of the activity, or over a period encapsulating the event or transient conditions identified
- Maximum values over the entire measurement, for each FFT frequency bin independently, these maxima combined into Third Octaves summed values as above.

5.11 The Time Averaged Vibration Level data is plotted against a range of VC (Vibration Criteria) curves used to assess or specify vibration levels affecting sensitive equipment (Reference1). These are not fully relevant to compare with measurement data taken at source, except to indicate the orders of magnitude of attenuation that may be required over the full propagation from source to the sensitive equipment siting in the neighbouring building.

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6 DATA & OBSERVATIONS

6.1 Concrete Mixing

The accelerometer was placed on the concrete floor of the concrete mixing lab, around 100mm from the base plate edge of the mixer.

Figure 1: Concrete Mixer under test

The concrete mixer was loaded by the technician, first with the dry mix and then with the liquid added. Two subsequent measurements were made during the dry mix part of the process, with a third after the liquid components had been added.

File	Time	Activity/Equipment	Test location	Case/Condition
Mixing1	10:14	Concrete Mixer	100mm from base plate edge.	Case 1: Dry Mix 1
Mixing2	10:15	Concrete Mixer	100mm from base plate edge.	Case 2: Dry Mix 2
Mixing3	10:16	Concrete Mixer	100mm from base plate edge.	Case 3: Wet Mix

Table 2: Analysis Cases - Concrete Mixer

See Figure 2193-R01-F02 (Reference 3) for an overview of the analysed cases.

It was noted that:

- As expected, vibration energy measured was broadband in nature (non-harmonic)
- No significant distinction was noted between the three Cases, including the Wet Mix

Case 2 (Dry Mix 2) has been analysed in third octave bands – see 2193-R01-F03 (Reference 4). It is noted that:

- Z-Axis vibration levels dominate, at around 10-20dB higher than the X and Y axes.
- Time-averaged vibration levels in the Z-Axis measured around 0.04 to 1.0 mm/s rms per third octave band, over the range measured up to the 400Hz band.

6.2 Beam Casting Shaker

The accelerometer was placed on the concrete floor of the concrete mixing lab (same slab section), around 100mm from the base foot of the shaker, at the motor end.

Figure 2: Beam Casting Shaker under test

The Shaker was first run up and down unloaded, ie without any concrete in the beam casting trough (Case 1).

Concrete was loaded by the Technician up to half depth (as is common to do so) and the shaker run up, sustained, and run down again (Case 2).

Concrete was loaded by the Technician up to full depth and the shaker run up, sustained, and run down again (Case 3).

File	Time	Activity/Equipment	Test location	Case/Condition
CastingEmpty	10:21	Beam Vibrator	100mm from foot edge at motor end, on same slab	Case 1: Unloaded
Casting1	10:24	Beam Vibrator	100mm from foot edge at motor end, on same slab	Case 2: Half filled
Casting2	10:34	Beam Vibrator	100mm from foot edge at motor end, on same slab	Case 3: Full

Table 3: Analysis Cases – Beam Casting Shaker

See Figure 2193-R01-F04 (Reference 5) for an overview of the analysed cases.

It was noted that:

- As expected, vibration energy measured was harmonic in nature, with energy value peaks easily observed at what appear to be discrete excitation frequencies (eg of the various rotating elements) and harmonics of these. The frequencies of excitation (and of corresponding harmonics) rise in value with running up and drop again with running down. These can be seen clearly in the spectrograms.
- Being rotational, the principal excitations run through all frequencies upwards from '0Hz'.
- Analysis has concentrated on the dominant Z-Axis excitation.

- In Case 1 (unloaded), the strongest harmonic rises up to 105Hz, measuring 10-14dB (ref 1 mm/s rms).
- In Case 2 (half load), the fundamental rises up to 70Hz, measuring 10-12dB (ref 1 mm/s rms), and sustains at that level and frequency for around 20-30 seconds before running down.
- In Case 3 (full load), the fundamental rises up to 50-60Hz, measuring 8-10dB (ref 1 mm/s rms), and sustains at that level and frequency for around 20-30 seconds before running down.

Case 1 (unloaded) has been analysed in third octave bands – see 2193-R01-F05 (Reference 6). It is noted that:

- Z-Axis vibration levels dominate, at around 10-20dB higher than the X and Y axes.
- Time-averaged vibration levels in the Z-Axis measured around 0.2 to 2.0 mm/s rms per third octave band, over the range measured up to the 250Hz band, dropping away quickly at higher bands.

6.3 Shaker Table – Mid Height

The accelerometer was placed on the concrete floor of the concrete mixing lab (same slab section), at 100mm from the base plate of the shaker table. The shaker table was mounted on vibration elastomeric isolation mounts onto the concrete slab.

Figure 3: Shaker Table under test

The Shaker was first run up and down unloaded, ie without any concrete in the block casting trough (Case 1).

Concrete was loaded by the Technician up to half depth (as is common to do so) and the shaker run up, sustained, and run down again (Case 2).

Concrete was loaded by the Technician up to full depth and the shaker run up, sustained, and run down again (Case 3).

File	Time	Activity/Equipment	Test location	Case/Condition
ShakingEmpty	10:39	Shaker Table - mid height	100mm from base plate edge.	Case 1: Unloaded
Shaker1	10:41	Shaker Table - mid height	100mm from base plate edge.	Case 2: Half filled
Shaker2	10:45	Shaker Table - mid height	100mm from base plate edge.	Case 3: Full

Table 4: Analysis Cases – Beam Casting Shaker

See Figure 2193-R01-F06 (Reference 7) for an overview of the analysed cases.

It was noted that:

- As expected, vibration energy measured was harmonic in nature, with energy value easily observed at what appear to be discrete excitation frequencies (eg of the various rotating elements) and harmonics of these. The frequencies of excitation (and of corresponding harmonics) rise in value with running up and drop again with running down. These can be seen clearly in the spectrograms.
- Being rotational, the principal excitations run through all frequencies upwards from ‘0Hz’. The rise is swift, over 2-3 seconds, with the run-down taking 4-6s.

- Analysis has concentrated on the dominant Z-Axis excitation.
- In Case 1 (unloaded), the strongest harmonic rises quickly to 50Hz, measuring around 0dB (ref 1 mm/s rms), and sustains at that level and frequency for around 10 seconds before running down.
- In Case 2 (half load), the fundamental rises also to 50Hz, measuring -2dB (ref 1 mm/s rms), and sustains at that level and frequency for around 20-25 seconds before running down.
- In Case 3 (full load), the fundamental rises also to 50Hz, measuring -3.5dB (ref 1 mm/s rms), and sustains at that level and frequency for around 40 seconds before running down.

Case 1 (unloaded) has been analysed in third octave bands – see 2193-R01-F07 (Reference 8). It is noted that:

- Z-Axis vibration levels dominate, at around 10-20dB higher than the X and Y axes.
- Time-averaged vibration levels in the Z-Axis measured around 0.05 mm/s rms per third octave band below 50Hz, peaking at 0.7mm/s rms in the 50Hz band, dropping quickly at higher bands.
- In the X and Y axes, time-averaged vibration levels were measured around 0.02 mm/s rms at 12.5Hz and above, rising to 0.05 mm/s rms at 4.0 Hz and below.

6.4 Handheld Breaker

The accelerometer was placed on the concrete floor of the main Structures lab (same slab section), approximately 250mm from the impact point on a concrete sample, and around 500mm from a steel plate, both used in the tests.

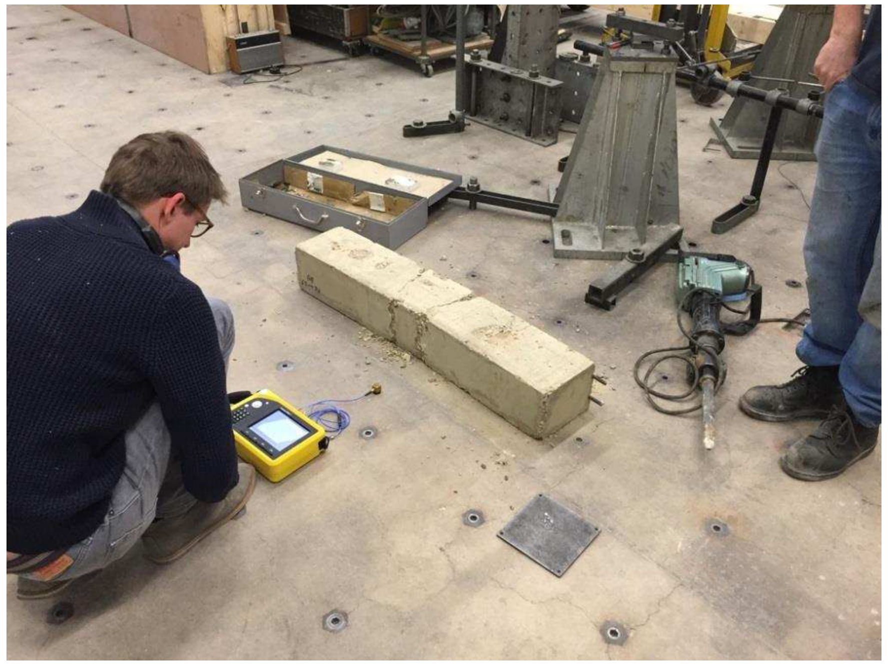
Figure 4: Handheld Breker test

The Breaker was first used on the concrete sample laid directly on the lab floor (Case 1), which was then repeated for Case 2. The Technician stood on the sample during the breaking action in each test.

For Case 3, the Breaker was applied to a 10mm steel plate laid directly on the lab floor.

File	Time	Activity/Equipment	Test location	Case/Condition
Kango1	11:13	Kango hammer	250mm from concrete beam rested on floor of structures lab	Case 1: Concrete beam
Kango2	11:14	Kango hammer	250mm from concrete beam rested on floor of structures lab	Case 2: Concrete beam
Kango-Steel	11:15	Kango hammer	500mm from steel plate rested on floor of structures lab	Case 3: onto 10mm steel plate

Table 5: Analysis Cases – Beam Casting Shaker

See Figure 2193-R01-F08 (Reference 9) for an overview of the analysed cases.

It was noted that:

- As expected, vibration energy measured was percussive in nature
- Onto the concrete sample, the z-axis vibration levels dominated by 25-60dB
- Onto the steel plate, the x-axis and y-axis vibration levels are higher than the z-axis levels by around 0-15dB.

Case 1 (concrete) has been analysed in third octave bands – see 2193-R01-F09 (Reference 10). It is noted that:

- Z-Axis vibration levels dominate, at around 25-60dB higher than the X and Y axes, being highest at low frequencies and dropping consistently with rising frequency band.
- Excitation is non-resonant, with the frequency content linked to the impact repetition rate. Note that the measurement is very close to a small impact site, unlike other tests relating to larger rotating equipment where the source size is considerably larger and excitation is by rotation. For the Breaker, this has resulted in high apparent 'source' values.

Case 3 (steel) has been analysed in third octave bands – see 2193-R01-F10 (Reference 11). It is noted that:

- X-Axis and Y-Axis vibration levels dominate, at around 20dB higher than the Z-Axis, being highest at low frequencies and dropping consistently with rising frequency band.
- Excitation is non-resonant, with the frequency content most likely to be linked to the impact repetition rate. Note that the measurement is very close to a small impact site, unlike other tests relating to larger rotating equipment where the source size is considerably larger and excitation is by rotation. For the Breaker, this has resulted in high apparent 'source' values.

Compared to the concrete breaking case, the impacts onto the steel plate exhibit around 10-15dB lower levels in the Z-Axis. This energy in the steel case appears to have been transferred laterally to the X and Y-Axes, which exhibit considerably higher vibration velocity levels.

6.5 Fork Lift Drop

The accelerometer was placed on the concrete floor of the main Structures lab (same slab section), around 500mm from the one of two wooden bearers.

Figure 5: Fork Lift Drop test

A load of around 750kg was 'dropped' by releasing the pneumatic lift on forks from a height of around 700mm. This was repeated over 3 examples.

File	Time	Activity/Equipment	Test location	Case/Condition
Fork1	11:48	Fork Lift drop 1	500mm from bearers	Case 1: example 1
Fork2	11:48	Fork Lift drop 2	500mm from bearers	Case 2: example 2
Fork3	11:53	Fork Lift drop 3	500mm from bearers	Case 3: example 3

Table 6: Analysis Cases – Beam Casting Shaker

See Figure 2193-R01-F11 (Reference 12) for an overview of the analysed cases.

It was noted that:

- Within each recording, the 'event' of the impact is more easily identifiable in the Z-axis trace (as shown), whereas the energy in all 3 axes is similar. If anything, levels are slightly higher in the X-Axis.

Case 1 has been analysed in third octave bands – see 2193-R01-F12 (Reference 13). It is noted that:

- Excitation is non-resonant, with low energy levels rising to 0.08mm/s rms below 8.0Hz.
- Above 50Hz, levels drop quickly below 0.01mm/s rms.
- No particular axis appears to dominate the values.

SOUND SPACE VISION / SOURCE VIBRATION LEVELS OF STRUCTURES LAB, CUED

6.6 Gantry Crane

The accelerometer was placed on the mezzanine floor overlooking the main Structures lab, around 2.5m from a structural steel column supporting the beam on which the Gantry Crane runs.

Figure 6: Fork Lift Drop test

Measurements were made while the crane was operated through its range.

See Figure 2193-R01-F13 (Reference 14) for an overview of the analysed data.

It was noted that:

- Levels were not significantly greater in any one axis.
- Levels are generally only slightly above the measured background values (see 2193-R01-F17, Reference 18), with occasional short time-base exceptions.

Case 1 has been analysed in third octave bands – see 2193-R01-F14 (Reference 15).

6.7 Glulam Split

The accelerometer was placed on the main Structures Lab floor, around 100mm from one of the supports bearing a span of glulam beam. The beam was stress tested under a mid-span load, until a break occurred. Vibration testing captured the moment the break occurred, allowing the impulsive force into the floor to be registered.

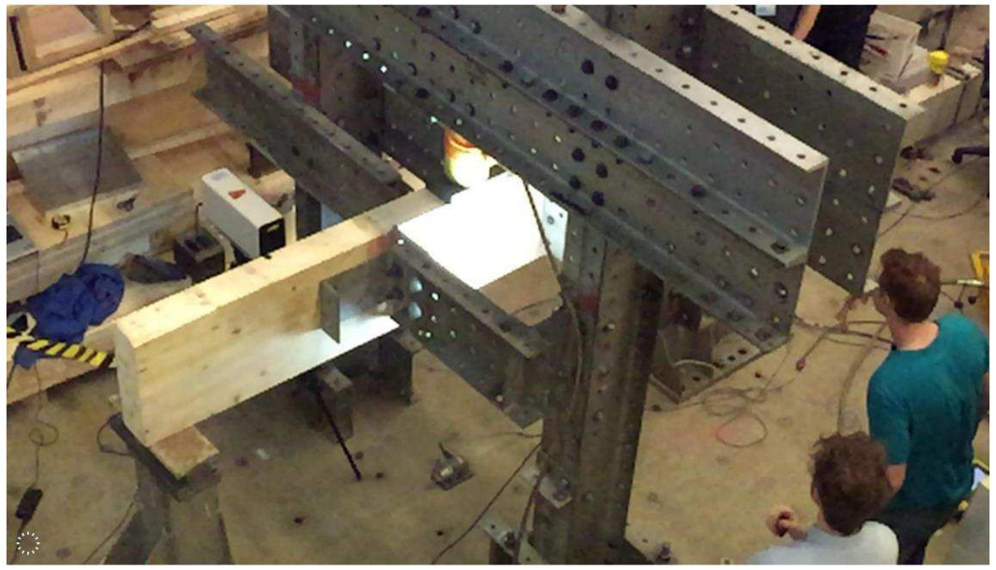

Figure 7: Glulam Split test

See Figure 2193-R01-F15 (Reference 16) for an overview of the analysed data.

It was noted that:

- The split event was easily identifiable in all axes, with no axis dominating the levels measured.

The break event has been analysed in third octave bands – see 2193-R01-F16 (Reference 17).

- The significant energy of the event occurs above 100Hz, peaking around 315-500Hz at less than 0.1mm/s rms in all axes.

6.8 Background Levels

Background spectra were measured on the main Structures Lab floor and on the Mezzanine Floor, for comparison with relevant measurement data.

See 2193-R01-F17 (Reference 18)

7 CONCLUSIONS

7.1 Vibration Velocity Levels have been measured close to typical activities at the CUED Structures Lab, for activities identified as being potential sources of vibration energy from rotational or impact input.

7.2 Levels were measured as 0.4s samples and FFT analysed into corresponding 2.5Hz bins. These were combined and divided to form time-averaged energy values in third octaves from 2.5Hz to 1000Hz.

7.3 In each event, the 'typical worst case' vibration event within the activity type was identified within the time traces, and spectral energy-averaged data is presented for those periods. Maxima data is also presented for each test analysed, as part of the context for characterising the vibration source levels to take forward into propagation analysis.

7.4 Background vibration levels are also given, as context.

7.5 The Levels reported can be investigated to identify:

- critical activities (in the context of expected frequency of occurrence and period of use)
- characteristic levels to apply, along with propagation analysis, to evaluating net vibration levels in sensitive spaces.

7.6 It is expected that propagation analysis will occur at the next stage, including site measurements and other techniques. As this analysis is expected to be necessarily circumspect to some extent, due to the multiple mechanisms occurring in geotechnical and structural vibration transfer functions, the data here should be used to understand a characteristic range of vibration levels and spectral content to apply at source.

Measurements of the geological transfer function between buildings on the new site will be obtained in the next stage of work.

It is envisioned that the floor of the future civil/structural lab will be a heavy slab of similar thickness to the slab in the existing building. Structural dynamics modelling can be adjusted for differences in boundary conditions.

Vibration levels in the new building and other surrounding sensitive buildings can be projected from these source levels, propagation functions and transfer within buildings by the design team.

SOUND SPACE VISION
bob.essert@soundspacevision.com

Appendix 12.7 Calibration certificates

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, CM6 1HD, England
www.campbell-associates.co.uk
info@campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION UKAS Laboratory 0789

Certificate number: U15237 (Supplement)

Certificate of Calibration and Conformance

Test object:	**Sound Calibrator**
Manufacturer:	**Brüel and Kjær**
Type:	**4231**
Serial no:	**2619374**

Customer:	Brett Consulting Limited
Address:	Imperium, Imperial Way, Reading, Berkshire. RG2 0TD.
Contact Person:	Adam Bamford - Assistant Engineer
Order No:	Contract: 22042

Measurement Results:	Level	Level Stability	Frequency	Frequency Stability	Distortion
1:	94.05 dB	0.06 dB	999.98 Hz	0.00 %	0.33 %
2:	94.05 dB	0.06 dB	999.97 Hz	0.00 %	0.33 %
3:	94.05 dB	0.06 dB	999.97 Hz	0.00 %	0.33 %
Result (Average):	**94.05 dB**	**0.06 dB**	**999.97 Hz**	**0.00 %**	**0.33 %**
Expanded Uncertainty:	0.10 dB	0.02 dB	1.00 Hz	0.01 %	0.10 %
Degree of Freedom:	>100	>100	>100	>100	>100
Coverage Factor:	2.00	2.00	2.00	2.00	2.00

The stated level is relative to 20μPa. The level is traceable to National Standards.
The stated level is valid at reference conditions. The following correction factors have been applied during the measurement: Pressure: 0.00008 dB/kPa Temperature: 0.0015 dB/°C Relative humidity: 0.001 dB/%RH Load volume : 0.0003 dB/mm3
The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.
Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2014\BNK4231v1_2619374_M1.nmf

Environmental conditions:	Pressure:	Temperature:	Relative humidity:
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	99.079 ± 0.042 kPa	23.4 ± 0.2 °C	46.1 ± 1.4 %RH

Date received for calibration:	13/01/2014
Date of calibration:	15/01/2014
Date of issue:	17/10/2016
Engineer	Palanivel Marappan B.Eng(Hons), M.Sc
Supervisor	Darren Batten TechIOA

Certificate number: U15237

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Measurements
The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Instruments and program
A complete list of equipment, hardware and software that has been used in this calibration is available from the calibration laboratory on request.

Traceability
The measured values are traceable to the following laboratories:
Sound Pressure Level: National Physical Laboratory, United Kingdom
Voltage: National Physical Laboratory, United Kingdom
Frequency: National Physical Laboratory, United Kingdom
Ambient Pressure: National Physical Laboratory, United Kingdom
Temperature & Relative Humidity: National Physical Laboratory, United Kingdom

Comment
Plus 20dB spot check = 114.07dB. Note this is not UKAS data
Supplement to original calibration certificate. Certificate re-issued at customer request.

Statement of conformance
As public evidence was available[1], from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in annex A of BS EN IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of that BS EN IEC 60942:2003.

[1] This evidence is held on file at the calibration laboratory.

Notes:
The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in **BOLD** are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Measurements performed by
Campbell Associates
Sonitus House, 5b Chelmsford Road Industrial Estate, Great Dunmow, GB-CM6 1HD
Tel (+44) 01371 871030 Fax (+44) 01371 879106
email calibration@campbell-associates.co.uk

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue 12 September 2014
Customer Brett Consulting Limited
Certificate Number CONF091416

	Manufacturer	Type	Serial Number
Acoustic Calibrator	Rion	NC-74	34746691

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 60942:2003 Class 1 (Electroacoustics - Sound Calibrators)

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Signed. Amrat C. Patel Position. Laboratory Manager. Date. 12 September 2014.
Amrat C Patel

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue 12 September 2014
Customer Brett Consulting Limited
Certificate Number CONF091417

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Signed. Amrat C. Patel Position. Laboratory Manager. Date. 12 September 2014.
Amrat C Patel

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL
☎ 01908 642846 🖷 01908 642814
✉ info@noise-and-vibration.co.uk 💻 www.noise-and-vibration.co.uk
ACOUSTICS NOISE AND VIBRATION LIMITED. REGISTERED IN ENGLAND NO. 3549028. REGISTERED OFFICE AS ABOVE.

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**31 July 2014**
Customer	**Brett Consulting Limited**
Certificate Number	**CONF071420**

	Manufacturer	Type	Serial Number
Sound Level Meter	Rion	NL-52	00542902
Preamplifier	Rion	NH-25	42930
Microphone	Rion	UC-59	06479

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 61672-1:2002 Class 1.

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Signed. Amrat C Patel Position.Laboratory Manager...Date.31st July 2014.

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**31 July 2014**
Customer	**Brett Consulting Limited**
Certificate Number	**CONF071421**

	Manufacturer	**Type**	**Serial Number**
Sound Level Meter	Rion	NL-52	00542903
Preamplifier	Rion	NH-25	42931
Microphone	Rion	UC-59	06480

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 61672-1:2002 Class 1.

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Signed. *Amrat C. Patel* ... Position. Laboratory Manager... Date. 31st July 2014.

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MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**31 July 2014**
Customer	**Brett Consulting Limited**
Certificate Number	**CONF071419**

	Manufacturer	**Type**	**Serial Number**
Sound Level Meter	Rion	NL-52	00542901
Preamplifier	Rion	NH-25	42929
Microphone	Rion	UC-59	06478

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 61672-1:2002 Class 1.

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Signed. Amrat C Patel Position.Laboratory Manager...Date.31st July 2014.

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ACOUSTICS NOISE AND VIBRATION LIMITED. REGISTERED IN ENGLAND NO. 3549028. REGISTERED OFFICE AS ABOVE.

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
www.campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION UKAS Laboratory 0789

Certificate of Calibration

Certificate number: U15173

Test object:	**Sound Level Meter, Type 1 (Precision)**
Manufacturer:	**Brüel and Kjær**
Type:	**2250**
Serial no:	**2626231**

Customer:	**Brett Consulting Limited**
Address:	**10 Queen Square,**
	Bristol. BS1 4NT.
Contact Person:	**Zoe Richardson.**

Method :
Calibration has been performed as set out in CA Technical Procedures TP01 & 02 as appropriate. The following items have been calibrated as set out in BS 7580 Part 1:1997

	Producer:	Type:	Serial No:	Certificate number
Microphone	Brüel & Kjær	4189	2621209	15172
Calibrator*	Brüel and Kjær	4231	2619373	U15171
Preamplifier	Brüel & Kjær	ZC0032	8125	Included

Additional items that also have been submitted for verification

Wind shield	None
Attenuator	None
Extension cable	None

These items have been taken into account wherever appropriate.

Environmental conditions:	Pressure:	Temperature:	Relative humidity:
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	100.844 kPa	24.2 °C	46.1 %RH

Date received :	20/12/2013
Date of calibration:	08/01/2014
Date of issue:	08/01/2014

Engineer

Michael Tickner

Supervisor

Darren Batten Tech IOA

* The calibrator was complete with any required coupler for the microphone specified

Calibration Certificate

UKAS Laboratory Number 0789

Certificate No.: U15173

Method

From markings on the sound level meter or by reference to the manufacturer's published literature it has been determined that the instrument submitted for verification was originally manufactured to BS EN 60651 and or BS EN 60804. The reference range, reference sound pressure level, primary indicator range, secondary indicator range, pulse range, linearity range and display range as specified by the manufacturer were used for the verification. The sound level meter was set to A weighting and adjusted to read correctly in response to the associated sound calibrator the reading was derived from the calibrator calibration certificate and manufacturer's instruction manuals. A measurement of the self noise of the sound level meter was then made using a dummy microphone having a capacitance of ±20% of the associated microphones self capacitance. The sound level meter was then tested, and its overall sensitivity adjusted, in accordance with Section 5 of BS 7580:Part 1:1997. The acoustic calibration at 1 kHz specified in sub-clause 5.6.1 of the standard was performed by application of a reference sound calibrator, whilst the tests at 125 Hz and 8k Hz (sub-clause 5.6.2) were performed by the electrostatic actuator method. At the end of the test, the associated sound calibrator was reapplied to the sound level meter and the meter reading was recorded and is noted below in the statements section.

Traceability :
The following measured values are traceable to the National Physical Laboratory, United Kingdom.
Sound Pressure Level, Voltage, Frequency, Barometric Pressure, Temperature & Relative Humidity

Measurement Results:

Calibration of sound level meter - BS7580 #5.4	Passed
Noise test - BS 7580 #5.5.2	Passed
Level Linearity Test - BS 7580, #5.5.3	Passed
Frequency weightings: A Network - BS 7580 #5.5.4	Passed
Frequency weightings: C Network - BS 7580 #5.5.4	Passed
Frequency weightings: Z Network - BS 7580 #5.5.4	Passed
Time weightings F and S - BS7580 #5.5.5	Passed
Peak response - BS7580 #5.5.6	Passed
RMS accuracy - BS7580 #5.5.7	Passed
Time weighting I - BS7580 #5.5.8	Passed
Integrating Test : Time averaging - BS7580 #5.5.9	Passed
Integrating Test : Pulse range - BS7580 #5.5.10	Passed
Integrating Test : Sound exposure level - BS7580 #5.5.11	Passed
Overload SPL Test - BS 7580 #5.5.12	Passed
Overload Leq Test - BS 7580 #5.5.12	Passed
Acoustic tests - BS 7580 #5.4 and 5.6	Passed
Summation of acoustic tests - BS 7580 #5.5.4	Passed

Statements
The sound level meter in the configuration tested conforms to the requirements of BS 7580 Part 1.
The self-generated noise recorded in the test specified in § 5.5.2 was: 12.9 (Below MSD)dB(A), 15.0 (Below MSD)dB(C) and 25.4dB(Z).
The final response obtained using the associated calibrator was (§5.6.3): 93.9dB(A)
This reading should be used henceforth to set up the sound level meter for field use.
A stricter test than that specified in paragraphs 5.5.6 of BS7580:1997 has been used by verifying that the 10 ms reference pulse is also correct. The level uncertainty of the Laboratory's 1 kHz sound calibrator used during this verification is ± 0.1 dB.
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The sound level meter in the configuration tested was found to comply with BS 7580:1997 part 1 for a type 1 device. The associated calibrator has been corrected for barometric pressure at the time of calibration in accordance with the relevant manufacturer's instructions

K:\C A\Calibration\Nor-1504\Nor-1019 SlmCal\2014\BNK2250_2626231_M1.doc

Cert_U7580 v8.0

Appendix 12.8 Multi storey car park noise calculations

31500 - West Cambridge Proposed Carpark Assessment

Receptor The Lawns off Clark Maxwell Road

Car Park	Event	Number of Events	SEL	Average Distance to Receptor (m)	Distance Correction	Location Correction	Corrected SEL	Calculated Sound Level at Receptor (LAeq,1hour)
AM Peak	Car Pass-by and Park	266	74	130	-16	3	61	49
	Engine Starting and Car Pulling Away	52	77	130	-16	3	64	45
	Calculated Sound Level at Receptor (LAeq,1hour)	51						
	Existing Residual Sound Level at Receptor (LAeq,1hour)	51						
	Cumulative Ambient Sound Level at Receptor (LAeq,1hour)	54						
	Difference	3						

Car Park	Event	Number of Events	SEL	Average Distance to Receptor (m)	Distance Correction	Location Correction	Corrected SEL	Calculated Sound Level at Receptor (LAeq,1hour)
PM Peak	Car Pass-by	48	74	130	-16	3	61	42
	Engine Starting and Car Pulling Away	139	77	130	-16	3	64	49
	Calculated Sound Level at Receptor (LAeq,1hour)	50						
	Existing Residual Sound Level at Receptor (LAeq,1hour)	49						
	Cumulative Ambient Sound Level at Receptor (LAeq,1hour)	53						
	Difference	4						

31500 - West Cambridge Proposed Carpark Assessment

Receptor 53 Madingley

Car Park	Event	Number of Events	SEL	Average Distance to Receptor (m)	Distance Correction	Location Correction	Corrected SEL	Calculated Sound Level at Receptor (LAeq,1hour)
AM Peak	Car Pass-by and Park	266	74	50	-12	3	65	53
	Engine Starting and Car Pulling Away	52	77	50	-12	3	68	49
	Calculated Sound Level at Receptor (LAeq,1hour)	55						
	Existing Residual Sound Level at Receptor (LAeq,1hour)	57						
	Cumulative Ambient Sound Level at Receptor (LAeq,1hour)	59						
	Difference	2						

Car Park	Event	Number of Events	SEL	Average Distance to Receptor (m)	Distance Correction	Location Correction	Corrected SEL	Calculated Sound Level at Receptor (LAeq,1hour)
PM Peak	Car Pass-by	48	74	50	-12	3	65	46
	Engine Starting and Car Pulling Away	139	77	50	-12	3	68	54
	Calculated Sound Level at Receptor (LAeq,1hour)	54						
	Existing Residual Sound Level at Receptor (LAeq,1hour)	57						
	Cumulative Ambient Sound Level at Receptor (LAeq,1hour)	59						
	Difference	2						

Appendix 12.9 Access route noise calculations

BS4142 Assessment Weekday Daytime

	Seconds
Assessment Period	3600

BS4142 Assessment Delivery Noise - Delivery Period	Lorry Arriving	Lorry Door Slam	Opening Lorry Shutter	Removing Support Bars	Moving Roll Cages Inside Lorry	Unloading cages	Wheeling roll cages off into store	Wheeling empty cages from inside store to outside	Loading empty roll cages onto lorry	Securing Support Bars	Closing lorry shutter	Door Slam	Lorry starting	Reversing Alarm	Lorry driving away
Sound Exposure Level (SEL)	68	83	76	88	93	94	97	92	95	88	76	83	89	94	68
Source Measurement Distance	1	1	1	4	3	1	1	4	1	4	1	1	1	1	1
Number of Events	1	1	1	1	14	14	14	14	14	3	1	1	1	1	1
Average Distance to Receptor (m)	20	70	70	70	70	70	70	70	70	70	70	70	70	70	20
Distance Loss	-26	-37	-37	-25	-27	-37	-37	-25	-37	-25	-37	-37	-37	-37	-26
Reflections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acoustic Feature Correction	0	3	0	0	0	0	0	0	0	0	0	3	0	6	0
Acoustic Screening	0	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	0	0
Rating Level)dB Laeq,1hour)	**6**	**8**	**-2**	**22**	**37**	**28**	**31**	**38**	**29**	**27**	**-2**	**8**	**11**	**27**	**6**
Combined Rating Level (dB Laeq, 1hour)	**42**														
Background Noise Level	**47**														
Comparison	**-5**														

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