REPORT

3 MARCH 2024

PRE-CONSTRUCTION INFORMATION

UPPER BROOK STREET – ENABLING AND DEMOLITION PHASE
MCLAREN DEVELOPMENTS

Prepared By



RLB Rider Levett Bucknall

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AUTHORISATION

This report has been prepared by:

and authorised for issue by:

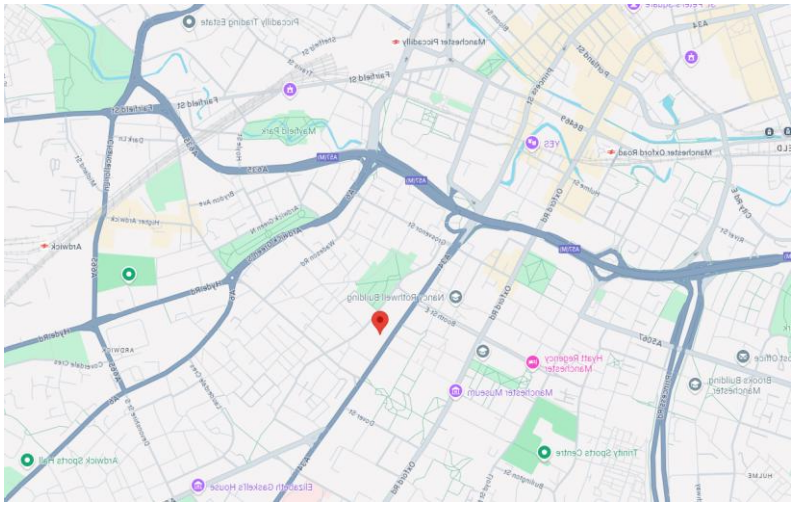


1.0 DESCRIPTION OF PROJECT

1.1.1 SITE LOCATION

The Site is located in Manchester on the site of a previous car dealership. The site is south east of Manchester city centre between Upper brook St and Kincardine Rd.

53-57 Upper Brook St, Manchester M13 9QD



Red showing the site located on the A34, just south of the A57(M)



1.1.2 THE WORKS TO BE UNDERTAKEN

The enabling works consist of HV diversion works, demolition of the exiting building situated on the site, bulk excavations and reduced level dig along with the associated site clearance activities. The enabling works forms part of the wider Upper Brook Street Masterplan.

1.2 KEY DATES

1.2.1 PROJECT PROGRAMME

- Project Start Date: The enabling works are expected to commence May 2025
- Project Duration: Approximately 17 weeks
- Project Completion Date: The enabling works are expected to be completed September 2025

All dates are to be confirmed by the Principal Contractor and agreed with the client.

The Principal Contractor will be required to provide a detailed programme of works.

1.2.2 TIME ALLOWANCE

The minimum time to be allowed between Principal Contractor's appointment and instruction to commence work on site

- Time allowed: 4 weeks

1.3 PROJECT DIRECTORY

[redacted]

1.3.2 PROJECT MANAGEMENT

[redacted]

1.3.3 CDM PRINCIPAL DESIGNER

[redacted]

1.3.4 BSA PRINCIPAL DESIGNER

[redacted]

1.3.5 ARCHITECT:

[redacted]

1.3.6 STRUCTURAL ENGINEER:

[redacted]

1.3.7 MEP CONSULTANCY :

[redacted]

1.3.8 COST MANAGEMENT

[redacted]

1.3.9 LANDSCAPE ARCHITECT:

[redacted]

1.3.10 LOCAL AUTHORITY:

[redacted]

1.3.11 HSE LOCAL OFFICE:

[redacted]

1.3.12 ENVIRONMENTAL AGENCY:

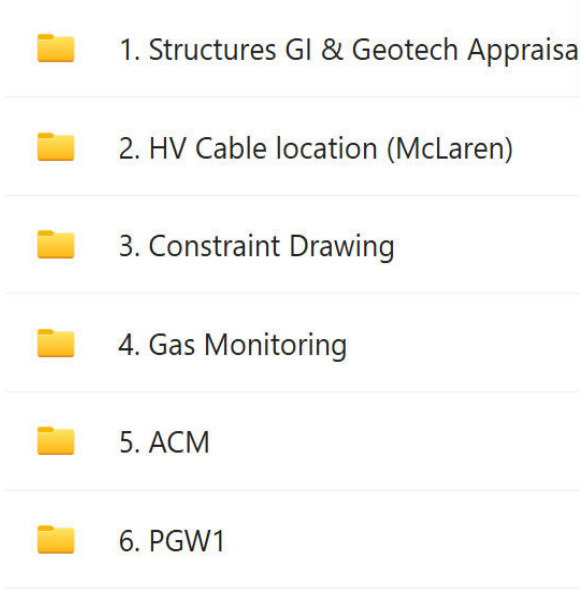
[redacted]

1.3.13 PRINCIPAL CONTRACTOR:

[redacted]

1.4 EXISTING INFORMATION

Existing information and supporting documentation used in production of this PCI are detailed in Appendix B and also located on Asite, these consist of the following:



2.0 CLIENT'S CONSIDERATIONS AND MANAGEMENT REQUIREMENTS

2.1 ARRANGEMENTS FOR:

2.1.1 PLANNING AND MANAGING WORKS

The Client must ensure that all the companies appointed to design these works and fulfil the role of Principal Contractor have the necessary skills, knowledge and experience and fully resourced to carry out their respective roles. Therefore all designers and tenderers must forward relevant company Health and Safety information when requested.

In accordance with Construction (Design and Management) Regulations 2015 (CDM 2015), all designers must incorporate 'The Principles of Prevention' as shown in Appendix 1 of the L153 guidance 'Managing Health and Safety in Construction.

The Principal Contractor is to ensure that their Construction Phase Plan is available to, and implemented by, all contractors and site operatives. The 'Plan must be reviewed on a regular basis and revised as necessary to reflect the current site situation. Any shortcomings noted by site operatives are to be addressed and recorded as necessary.

2.1.2 HEALTH AND SAFETY GOALS

The designers and Principal Contractor should consider incorporating the latest HSE safety goals and initiatives, into their designs and the Construction Phase Plan. These goals and initiatives are available on the HSE website www.HSE.gov.uk.

The designers should consider incorporating Site-Specific Health & Safety Objectives within their designs for the Principal Contractor to consider and manage within their developed Construction Phase Plan they are:

- Existing Environmental Restrictions and Existing On-Site Restrictions detailed in Section 3 of this document, relevant valid licences and authorisations must be obtained prior to commencement of works.
- Actions to prevent uncontrolled contamination and pollution.
- Proper recording of all environmental actions for inclusion in the Health & Safety File.
- Additional objectives as required by site conditions.

The Client has key Health & Safety Objectives that should be considered for any impact on design work and incorporated in the Principal Contractor's Construction Phase Plan as required they are:

- To meet HSE priorities and strive to raise the standards above legal compliance.
- To ensure co-operation between all parties involved to complete the project safely.
- To raise the awareness of interaction between members of the public, site operatives and operations, preventing trespass etc and ensure liaison with the community occurs at all stages of the project.
- To have the works carried out in a manner which seeks to safeguard the safety, health and welfare of all those engaged in, or affected by, the works including site operatives and members of the public.
- Endeavour to achieve ZERO reportable RIDDOR accidents / incidents. Minimise the potential for falls from height, pedestrian / vehicular accidents, potential for slips, trips and falls. Any accident is to be properly investigated and recorded.

2.1.3 COMMUNICATION AND LIAISON BETWEEN CLIENT AND OTHERS

In accordance with CDM 2015 all members of the design team shall ensure that there is reciprocal exchange of information particularly where designs of one designer impacts on others. The Principal Designer should be the focal point for these exchanges, therefore ensure that the Principal Designer is included on significant exchanges of information between all parties during the design stages.

Clear lines of communications are to be established as required to ensure full reciprocal exchanges of information between all parties, particularly for the following situations:

- The Principal Contractor is to ensure that any existing fire and emergency procedures are discussed with the Client and incorporated as required into their Construction Phase Plan and communicated to all site operatives and suppliers. All resultant temporary changes to the existing procedures are to be communicated to affected parties.
- The Principal Contractor is to ensure that any existing delivery / traffic systems or restrictions and noise / dust issues are discussed with the client and incorporated as required into their Construction Phase Plan and communicated to all site operatives and suppliers. All resultant temporary changes to the existing procedures are to be communicated to affected parties.
- If other construction projects are being undertaken in the immediate vicinity, clear segregation and demarcation of each 'site' and communication to avoid potential hazards.
- Works in occupied areas will be fully co-ordinated with the Client liaison on a daily basis, a safe system of work must be followed for all such works, utilising a permit to work regime if necessary.
- See section 4 of this plan with regard to significant design changes.
- Liaison with the adjacent residents and business users during the demolition , site clearance, site hoarding line to be agreed – to be confirmed/agreed.

The Principal Contractor must develop the Construction Phase Plan as required by the regulations and this should include initial development of management and operational systems to safely mange the potential hazards highlighted in this document. The plan must be issued for the Client to review **prior to the commencement of works**.

The Principal Contractor is to ensure that all contractors' relevant information, risk assessments, method statements, COSHH assessments and product data is collected, reviewed, collated and incorporated into their Construction Phase Plan. All such information must be communicated to all other parties affected by it.

2.1.4 SITE SECURITY

The site is located within a congested area, with both residential and commercial buildings encompassing the site. There is also student accommodation located adjacent to the site. There can be a vast amount of footfall and vehicle movement within the vicinity. The Principal Contractor must ensure a suitable and sufficient Risk Assessment is conducted to highlight the level of risk associated with trespassing and unauthorized access onto site to determine the appropriate level of additional security arrangements that may be required.

The Principal Contractor should consider whether any additional fencing is required in order to safeguard the site, the works, products, materials, plant, buildings affected by the works and adjoining property from unauthorised access both during and outside working hours and erect as soon as reasonably practicable.

All persons working on or visiting the site should be required to sign in on arrival and sign out on departure. No persons should be allowed on site unaccompanied unless they have received a site-specific induction.

All areas of the construction site and compound within the overall site needs to be confined and defined by robust and secure temporary fencing to all boundaries with lockable gated access. If the compound is separated from the work area the Principal Contractor should consider the additional safety and security implications between the two areas.

Entrances into construction areas shall always be kept closed and secured when unattended. Gate personnel must be in attendance at all times to allow safe access and egress from the site. Any persons working on or visiting the site should be required to sign in on arrival and sign out on departure.

No persons should be allowed on site unaccompanied unless they have received a site-specific induction.

Warning signage must be established around the perimeter of the site to alert others and deter trespassers.

The Principal Contractor will develop their own site security measures to comply with the requirements of HSE Guidance HSG 151 Protecting the Public your next move.

All persons working on or visiting the site should be required to sign in on arrival and sign out on departure. No persons should be allowed on site unaccompanied unless they have received a site specific induction.

On an occupied site, the Principal Contractor is to discuss and agree the defined site and the permissions required to access areas outside the defined site.

2.1.5 WELFARE PROVISION

Welfare facilities are to be provided by the Principal Contractor from the beginning of the project to the end, they are to be in accordance with Schedule 2 of the CDM 2015, suitable and sufficient for the nature of the works to be undertaken and number of operatives expected on the site. These facilities are kept in a clean and orderly condition, as far as reasonably practicable.

Should the welfare facilities be located in close proximity to other buildings, the PC must review if the welfare cabins require to be fire rated and all material storage which is flammable must be stored in fire retardant storage containers as identified in a Construction Fire Risk Assessment.

Lighting luminaires and the locations to be considered across the site. The Principal Contractor must ensure additional lighting does not cause light nuisance / glare to adjacent hotel.

All materials brought to site must be stored in a safe and stable manner, therefore the Principal Contractor should consider specific requirements for storage, distribution and use of vulnerable and hazardous materials.

Develop safe working procedures for any work executed within the Compound, alternative locations should be considered for hazardous works (e.g. in a controlled workshop environment or closer to where materials are required). Security measures should be taken to prevent unauthorised access to the compound at all times.

2.2 HEALTH AND SAFETY REQUIREMENTS

2.2.1 SITE HOARDING

In respect of the position of the site in relation to the surrounding area, the Principal Contractors must ensure they highlight the proposed hoarding specification they will be utilising within their Construction phase plan. Warning signage must be established around the perimeter of the site to alert others and deter trespassers.

It has been confirmed there will be a requirement for a shared hoarding line to divide the construction sites. The Principal Contractor must highlight within their CPP who will be responsible for the TW design along with who will be installing /maintaining the hoarding line. Access requirements between the two sites must be considered when designing the separation to ensure access for emergency escapes for the site is not restricted.

2.2.2 TEMPORARY WORKS

The Principal Contractor must ensure they provide details of the proposed temporary works items and the arrangements for ensuring robust procedural control of all temporary works are to be included in the initial CPP. The Principal Contractor must highlight the following: (as applicable)

a) Who will be their Temporary Works Design Co-ordinator for the project (in-house or outsourced)

b) A copy of their Temporary Works Design management procedure

c) A schedule of specific temporary works design items for the project

All security fencing, hoarding, partitioning, etc. shall be secure and of adequate design and construction to withstand horizontal loading, e.g. wind loading all signage attached must be included in the Temporary Works design and included in the TW register as required

2.2.3 SITE TRANSPORT AND TRAFFIC MANAGEMENT

To the west of the site, the A34 (Upper Brook Street) runs parallel and is a congested multi-lane carriageway into the Manchester City Centre. To the East of the site Kincardine Road runs adjacent. Kincardine road operates on a one way system form the entrance to whiteKirk close (Pictured Below) and also contains a designated cycle lane making the road restricted. Inchley Road and Cottenham Street also run adjacent to the site. Ther is also a vast amount of vehicle movement and residential parking surrounding the site which may cause access restrictions for potential site plant and deliveries.





Tracking exercises may need to be carried out to ensure all proposed routes are achievable given the site constraints.

Due to the restricted space on site the PC should consider having deliveries scheduled in smaller quantities, reducing the risks associated with large HGVs entering construction sites.

In Accordance with CDM 2015 the Principal Contractor must include within their developed Construction Phase Plan a comprehensive management and operating procedure for controlling traffic whilst on site including specific arrangements for safe site access and egress. The Traffic Management Procedure should include:

- Arrangements to safely managed / eliminate hazards highlighted in sections 3.1.2 and 3.1.3 of this document.
- Arrangements for delivery and removal of plant and equipment, materials / waste and on site storage.
- On site traffic routes and segregation of vehicular and pedestrian routes.
- Contractor and Visitor parking arrangements.
- Specific requirements for controlling vehicle movement, including plant and equipment checking and maintenance strategies.

The Principal Contractor must establish the initial procedure prior to commencing works giving due cognisance to the site specific requirements. The procedure is to be regularly monitored, reviewed and revised to reflect the changing conditions on site to ensure site safety and security and appropriate and adequate segregation of site operatives and members of the public.

The restrictions and requirements of the procedure are to be included in Site Induction, inform all contractors and organise toolbox talks if the procedure is substantially altered.

Additional guidance can be obtained from the HSE publication ref: HSG 144 - ‘The safe use of vehicles on construction sites.

2.2.4 PERMIT-TO-WORK SYSTEMS

The Principal Contractor must ensure that all relevant notifications, licences and authorizations are applied for and in place prior to commencing works on site e.g. Section 80 and 81 –Demolition ,Section 60 and 61 – Noise, Asbestos Removal for licensable works, Section 278 – Highway works, DEFR licences etc.

The Principal Contractor must consider implementing a permit to work system for all Hot Works and Live Electrical Apparatus Works and for Excavations, Confined Space Entry works if they are potentially of an unusually hazardous nature. The 'Dial Before You Dig' arrangement with the local public utilities should also be considered in respect of services. See also Sections 3.1.5, 3.1.6, 4.1 and 4.3 for additional information.

All works deemed to require a Permit to Work are to be fully discussed prior to the works being carried out and the appropriate permit(s) completed. The Principal Contractor is to include in their developed Construction Phase Plan a detailed system for managing all works in progress being carried out under a Permit to Work with permits 'closed' and filed when works completed.

2.2.5 FIRE PRECAUTIONS AND EMERGENCY PROCEDURES

The Principal Contractor must ensure a suitable and sufficient fire risk assessment is conducted before commencement of works, along with a fire action plan that must be established and agreed if an emergency evacuation is required.

In accordance with CDM 2015 the Principal Contractor must include within their developed Construction Phase Plan a comprehensive management and operating procedure for monitoring and recording fire precautions including site specific arrangements for safe egress from the site or areas affected. The Fire Management Procedure should include:

- Provision of suitable and sufficient fire fighting and detection equipment, located in suitable positions on site.
- Position of assembly points.
- Regime of testing and inspecting fire fighting and detection equipment and all temporary electric supplies and electrical equipment.
- Regime for fire drills, procedures in the event of a fire and control of hot works.
- Storage requirements for flammable materials, bottled gases and diesel.
- Ensure site tidiness and regular waste removal to prevent build up of rubbish, particularly flammable materials.
- Provision for dealing with an environmental spill incident is to be provided by the provision of spill kits and associated training to designated personnel. In particular care is to be taken to ensure that no contamination enters the existing site drainage, the aquifer underlying the site or the production, monitoring and remediation boreholes located on the site.

The Principal Contractor must establish the initial procedure prior to commencing works giving due cognisance to the site specific requirements, ensuring interface with any / all existing procedures. The procedure is to be regularly monitored, reviewed and revised to reflect changes on site.

The restrictions and requirements of the Procedure are to be included in Site Induction, inform all contractors and organise toolbox talks if the procedure is substantially altered.

Fire Wardens / Marshals should be appointed to each project as required by the size and complexity of the project, to ensure the Fire Management Procedure is administered, monitored, reviewed and updated as necessary.

Additional guidance can be obtained from the HSE publication ref: HSG 168 – 'Fire Safety in Construction Work'.

2.2.6 SITE RESTRICTIONS / AUTHORISATION REQUIREMENTS

The project will be undertaken in accordance with all relevant Health and Safety Legislation including Approved Codes of Practice, Health and Safety Executive Guidance Notes, Health and Safety Standards, the Principal Contractor's Health and Safety Policy and Safety Rules.

The Principal Contractor is required to draw up a set of site rules; these rules should be specific to the site and pertain to site conditions and operations. The rules must be in writing, easy to understand, brought to everyone's attention and displayed on the site notice boards. Notice should be given to sub-contractors that these Rules will be enforced absolutely.

The Principal Contractor will designate a smoking area, clear of all welfare facilities and existing / newly completed or partially completed building/s, to cause least nuisance to others.

The Principal Contractor shall protect all adjacent facilities and site features against damage.

To comply with the requirement of a tidy site on a day-to-day basis, the materials removed from the compound area and brought into the main work area, (to the workface), should only be sufficient for short term needs.

All waste removed from site, including excavated spoil, must be handled and disposed of in accordance with all applicable regulations and must be accompanied by either a Waste Transfer Note or Hazardous Waste Consignment Note relating to the individual load. Only appropriately licensed waste carriers and disposal facilities may be used.

The Principal Contractor must ensure that all relevant notifications, licences and authorizations are applied for and in place prior to commencing works on site e.g. Section 80 and 81 – Demolition, Section 60 and 61 – Noise, Asbestos Removal for licensable works, Section 278 – Highway works, DEFRA licences etc. The Principal Contractor should ensure that all site operatives adhere to the requirements of all licences pertinent to this site.

3.0 ENVIRONMENTAL RESTRICTIONS AND EXISTING ON-SITE RESTRICTIONS

3.1 SAFETY HAZARDS

3.1.1 SITE AND SITE BOUNDARY TREATMENT

Description of the Overall Site – The site is an irregular shaped piece of land and comprises of a car dealer ship and servicing centre. A single storey building in is the central area of the site. External areas are all tarmac surfaces in the north there is a lean -too building formerly used for car cleaning and velatening.to the west of the site there is small structure that houses waste material and a small above ground oil tank

Description of the Site of the Works – The site of the works is within the overall boundary of the site and is confined to the service yard, where the CHP unit is to be sited, and back of store/ warehousing for mechanical and electrical connections to the existing plant.

Occupied buildings – The Principal Contractor is to establish the requirements for site operatives accessing areas outside the work site defined above.

Description of Boundary Treatments - The boundaries are well defined by existing walls, fences, hedges, there are gaps in the boundary, potentially compromising site security. The Principal Contractor should consider augmenting the existing with hoarding / Heras fencing to ensure site security. The site is predominately surrounded with a mix of brick walls and steel fence. The western section is open directly onto Upper Brook Street.

3.1.2 DELIVERY RESTRICTIONS AND WORKING HOURS

In accordance with any Planning Restrictions and Conditions, the site access must be via a specified route, to be agreed prior to commencement of works on site. The Principal Contractor should consider preparing a written route / map for notifying all delivery firms and drivers.

The access roads around the site are restricted with residents parking and one ways systems, the main upper Brook Street is congested throughout the day .There are parking restrictions outside the site in the form of double/ single yellow lines, therefore in respect of the parking restrictions the Principal Contractor is to ensure that all delivery firms and drivers are aware of these restrictions.

The Principal Contractor may need to liaise with the adjacent facilities to ensure deliveries schedules do not clash causing congestion and disruption.

Due to the restricted space on site the PC should consider having deliveries made in smaller quantities, reducing the risks associated with large HGVs entering construction sites.

The Principal Contractor shall address the following:

- Details of any transport requirements and local traffic restrictions e.g. parking restrictions etc.
- A marked-up site plan showing vehicle movement routes to and from the site
- All delivery of materials etc. shall be planned to avoid busy periods.
- Where practicable the Principal Contractor shall segregate pedestrian and vehicular traffic, on and off site.
- ALL reversing vehicles, when on site or adjacent thereto MUST be attended by a banksman.
- Adequate warning signs, traffic management systems and temporary barriers etc. shall be in place prior to construction commencing.
- Safe routes for distribution of materials around the site
- All highway systems to be kept clear, clean, and safe to the full satisfaction of the Client, the Police and Highway Authority

In accordance with the Planning Restrictions and Conditions the working hours will be 08.00 – 18.00 Monday – Friday, 08.00 -13.00 Saturday, No Working on Sunday or Bank Holidays without prior written permission from the Client.

There will be no waiting allowed on the public road outside the site or in the site entrance before site start time or during any specified times..

3.1.3 EXISTING TRAFFIC INCLUDING ACCESS TO SITE

The Principal Contractor will be required to obtain the required permits for any road closures and ensure any diversions are place prior to commencing the works

The Principal Contractor must incorporate existing conditions noted above into their Traffic Management Procedure as appropriate, giving due cognisance to the existing surrounding residential / commercial developments, existing vehicular traffic and pedestrian routes, the on-site works and how they interact.

The road outside the site must be kept clear at all times. The Contractor is to develop proposals within their Construction Phase Plan relative to maintaining secure access to the Works including provision of access for fire appliances and emergency service

3.1.4 ADJACENT LAND USES

The site comprises a former Citroen car dealership, MOT testing and servicing centre.

The western section of the building comprises the former showroom with first floor offices whilst the eastern section housed workshops used for servicing and vehicle testing.

The site is predominately surrounded with a mix of brick walls and steel fence. The western section is open directly onto Upper Brook Street.

To the east beyond Kincardine Road is student accommodation, to the south lies Elizabeth Yarwood Court, a former sheltered housing scheme that ceased to be operational in June 2021. Land to the north comprises another vacant former car dealership. West beyond Upper Brook Street are buildings of Manchester University and a Hospital, within close proximity

The Principal Contractor should consider reviewing their site management in line with the HSE guidance document – HSG 151 Protecting the public. This document provides guidance and practical advice to all those designing, planning, managing or carrying out construction work to identify and eliminate the hazards and control the residual risks to the public and others not directly involved.

3.1.5 EXISTING SERVICES

Cornerstone have carried out a Utilities report (attached within appendix B). The report highlights LP Gas main owned by Cadent Ltd is located running adjacent to the site along upper Brooks St. The Principal Contractor must liaise with Cadent Ltd to highlight if the planned works will impact the LP Gas main. Should any easement works be required this must be I agreement and coordinated with Cadent Ltd. Electricity Northwest report highlights a 6kv along with LV service cables running through the site. United Utilities sewer records indicate drainage pipes running under the existing building feeding into the main service drain.

Known existing services are shown on the survey drawings prepared for this project, each of these services should be either traced, marked and protected to avoid damage or cut back and made safe prior to commencement of works as dictated by requirements. There is also the possibility of unrecorded services to which the Principal Contractor is to remain vigilant.

The Principal Contractor and shall on appointment take responsibility for ascertaining the location and service types i.e. implement visual inspection, testing, CAT scan, radar survey, hand dig trial pits etc.

Interface between existing and new services may be encountered during work. The PC must ensure diversions or additional isolations are in agreement with the Client adjacent residents / businesses prior to any disconnections.

The Principal Contractor shall not rely only on the information provided but shall independently contact and liaise with the Utility providers before commencing any works.

The Principal Contractor must ensure any isolation of existing services must be managed and communicated with adjacent residents and existing occupiers of the existing business to ensure no disruption is caused to their operations during the isolation of these services.

All services, including those indicated as redundant, shall be treated as being live until proven otherwise.

Should any further isolations be required, they must be in agreement with the Client prior to any disconnections.

The Principal Contractor must liaise with the client to submit suitable notice should any disconnections be required to the services due to the clients' requirements for the equipment to stay operational throughout the works as far as reasonably practicable.

There may be a necessity to carry out diversion works into a live sewer. The health risks to site operatives and the public including risks of pollution of the existing sewer system and / or contamination of surrounding soil should be considered.

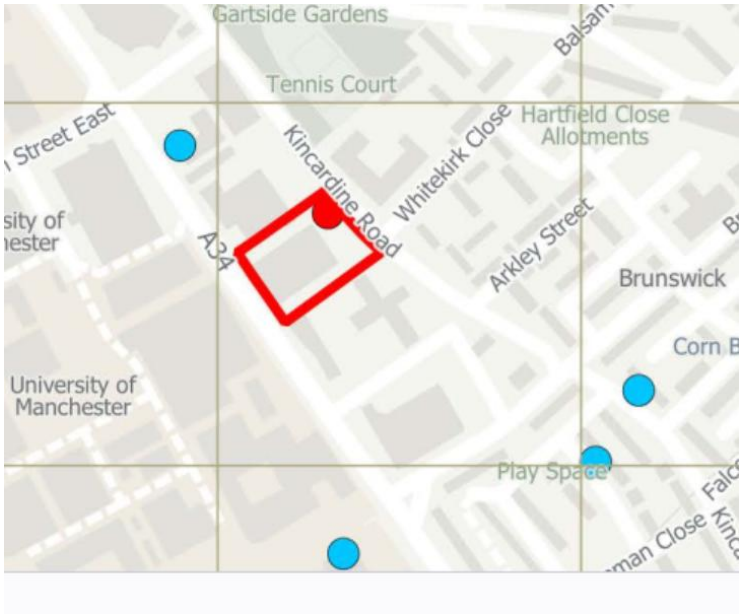
The Principal Contractor should assume that any/all services found as part of the investigation works are live until otherwise proven. Observance of the recommendations in HSE Guidance Note HS(G) 47 'Avoidance of underground services' may be prudent. It will be necessary to undertake a careful appraisal of the site prior to the commencement of the development to ensure that all live services have been identified and disconnected.

A Method Statement fully detailing the works on a step-by-step basis, including procedures and temporary works and special emergency procedures and appropriate management and operating systems to safely manage any potential hazards from these operations should be prepared and approved. This method statement could include: a Permit to Dig system; the 'Dial Before You Dig' arrangement with the local public utilities and a Permit for entry into confined spaces in especially hazardous conditions. It is recommended that specific PPE relevant to the nature of the works be worn and specialist equipment used as appropriate.

The Principal Contractor is to ensure that any services connected to adjacent occupied premises or other facilities are not disconnected or interfered with without due notice

3.1.6 GROUND CONDITIONS

A Detailed Unexploded Ordnance (UXO) Threat Assessment has been carried out by Landmark and Alpha Associates and the risk assessment is included in Appendix B. The risk posed by UXO has been assessed as HIGH. The report highlights a high explosive bomb risk within the site boundary (pictured below)



The following risk mitigation measures are recommended as a minimum in order to reduce risks ALARP during intrusive works

UXO Risk Mitigation Measures Overview							
Proposed Intrusive Works		Emergency Response Plan	Safety and Awareness Briefings	On-Call EOD Engineer	UXO Watching Brief	Non-Intrusive UXO Survey	Intrusive UXO Survey
Open Works	Trial Pits	✓	✓	✗	✓	✗	✗
	Excavations	✓	✓	✗	✓	✗	✗
Blind Work	Boreholes	✓	✓	✗	✗	✗	✓
Residual UXO Risk Rating		ALARP					

The report indicates a EOD Engineer in the Watching Brief Role; Where “open” intrusive works into previously undisturbed ground are proposed, an EOD Engineer should be present in the UXO Watching Brief role to monitor ongoing “open” intrusive works to identify any suspicious items that may be UXB or UXO.

Ground Investigation reports have also been prepared by Calabrian June 2024, included within Appendix B. The salient points of the report are included here but the Principal Contractor should ensure that the findings of the full report are taken into account when preparing their

Construction Phase Plan to ensure safe working methods are adopted for all excavation works.

The report highlights due to the previous building usage, there may be a potential for on-site contamination sources such as, spills and leaks from small above ground oil storage tank and drums. Spills and leaks from vehicles during maintenance.

The report states some limited contamination exists in the soils beneath this site. In order to assess the significance of this contamination, consideration must be given to the site's environmental setting and the proposed end use.

The underlying glacial deposits are classified as a secondary aquifer with the underlying Chester Formation being a principal aquifer. Therefore, the site's environmental setting is considered to be moderate sensitivity within the urban setting.

With respect to human health, the proposed end use (residential) is also sensitive. Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures.

The Principal Contractor will be required to undertake relevant investigations to identify any unknown floor or ground structures and any unknown ground contamination if not already completed.

Ground Investigation reports prepared by Calabrian highlights Asbestos was identified in four samples of made ground. Supplementary analysis yielded only two results above the limit of the measurement (0.001%).

Provided soils are kept damp the risk of airborne fibre release, even during disturbance associated with excavation, should be negligible, and certainly below the control limit (as set by the Control of Asbestos Regulations 2012) of 0.1 f/cm 3 airborne fibres averaged over a 4-hour period.

In respect that there is potential contamination on the site the Principal Contractor is to ensure that all spoil removed from site is disposed of at a licensed tip and that all waste transfer tickets, specialist carriers licence and tip licence are forwarded to the Principal Designer for inclusion in the Health

The site lies in both Flood Zones 2 and 3, where there is a risk of flooding from rivers but also appears to lie within a surface flooding area. The Principal Contractor must include within their CPP management Controls for the potential inspection and pumping procedures of any of excavations if required.

HSE Construction Information Sheet No 8 – Safety in Excavations. HSE Guidance document HS(G)185 Health and Safety in Excavation - Be Safe and Shore.

3.1.7 EXISTING STRUCTURES / PLANT & EQUIPMENT

No structural condition report of existing building. On the 4th of October 2022, Civic Engineers conducted an on-site visual survey. At the time of this report, access into the existing Citroen dealership building was not available.

A walk-around visual survey of the existing car park revealed no structure or historic repair works that would indicate a risk of hinderance or potential engineering challenges. Topography of the car park and surrounding area was relatively flat, with no major cracks found within the pavement that could have resulted from a high amount of ground settlement, for example.

The Principal Contractor must ensure suitable controls are established to ensure the columns to the under croft are protected during the movement of heavy plant and machinery during the construction phase to prevent collision and affecting the structural integrity.

The Principal Contractor must consider the structural integrity of the existing building should undermining of existing building / adjacent structures be required prior to the demolition for isolation or diversion of existing services

Generally before starting work examine all available information and documentation and discuss any areas of uncertainty with the Design Team. If the available information is considered to be insufficient, carry out appropriate surveys as directed prior to commencing any works to ensure that safe working procedures can be developed.

It is understood that there are no Health and Safety Files available for the site. Condition surveys of the buildings have been carried out and reports are available however the Principal Contractor must ascertain for themself any further information he may require to ensure the safety of all persons and the Works and compliance with current health and safety regulations.

Temporary and permanent works and shoring are to be carried out where necessary to ensure the full safety and structural integrity of the building during demolition.

The Principal Contractor should consider preparing risk assessments and management systems for the movement of all personnel around the site with special emphasis placed on the internal works; the removal of debris; the delivery of plant and materials, detailing systems proposed to protect members of the public, protecting the structure of the building and ensuring structural members are not overloaded.

The Principal Contractor should ensure that all voids are appropriately and adequately protected when left unattended.

Due to the nature of the site and the buildings to be demolished, the Principal Contactor must develop within the Construction Phase Plan management and operating procedures to ensure that operatives do not become isolated and that when parts are being demolished there are no persons still inside.

The Principal Contractor should develop within their Construction Phase Plan safe working methods to ensure that all scaffold and working platforms are kept clear of debris and that during demolition, the existing structure is not overloaded.

In accordance with the CDM Regulations 2015, the demolition or dismantling must be planned and carried out in a such a manner as to prevent danger or, where it Is not practicable to prevent it, to reduce danger to as low as reasonably practicable. The arrangements for carrying out such demolition must be recorded in writing before the demolition or dismantling work begins.

Consideration should be given to the depth and variability of the Made Ground and likelihood of trench collapse; it is considered that all excavations are supported or battered back. The Principal Contractor should refer to report attached.

Refer to BS 6187:2011 Code of Practice for Full and Partial Demolition for more information

3.2 HEALTH HAZARDS

3.2.1 EXISTING HAZARDOUS MATERIALS

3.2.1.1 Asbestos

Airbourne Environmental Consultant Ltd, conducted an Asbestos Demolition Survey 12 July 2024 and is included within Appendix B.

The report highlights Asbestos containing materials (ACMs) where identified within the pipework gaskets on the ground and first floor. The recommendation was the gaskets are to be removed prior to any demolition works commencing.

There were areas within the building the surveyor was not able to access noted below

- Drain covers were not lifted due to being sealed shut and specialist lifting equipment was needed, this was agreed with Phoebe shore via telephone on 10/07/2024.
- Limited access to high areas within warehouse 1 due to not being able to open roller shutter doors to get access with MEWP, no keys available

The Principal Contractor must ensure all restricted areas have the required surveys conducted prior to the works commencing to highlight the potential presence of any additional ACMs

Ground Investigation reports prepared by Calabrian highlights Asbestos was identified in four samples of made ground. Supplementary analysis yielded only two results above the limit of the measurement (0.001%).

Provided soils are kept damp the risk of airborne fibre release, even during disturbance associated with excavation, should be negligible, and certainly below the control limit (as set by the Control of Asbestos Regulations 2012) of 0.1 f/cm 3 airborne fibres averaged over a 4-hour period.

The PC must ensure the above requirements is highlighted within their CPP coordinated with the contractors on site

Should any additional work be required outside of the agreed scope where ACMs may be encountered i.e. excavations and service alterations that are not included in the exiting scope of works, the PC must ensure suitable investigations are conducted to determine if potential ACMS may be encountered.

The PC must consider Asbestos as a residual risk throughout the project and ensure management controls are in place should any potential ACMs be encountered during the works. Should any additional work be required where ACMs may be encountered i.e. excavations and service alterations the PC must ensure this is reviewed.

Any work with Asbestos must be conducted in accordance with the Control of Asbestos Regulations 2012 and any Local Authority guidelines to the satisfaction of the Local Authority's Safety Officer,

using a licensed approved specialist contractor if necessary. Such information will be included in the Health & Safety File.

All contractors on site must have received formal Asbestos awareness training and be aware of the procedures in place in the event of uncovering potential ACMs.

Any removal of asbestos is to be carried out by a licensed contractor. Any removal work shall be carried out by a specialist contractor in accordance with the Control of Asbestos Regulations 2012 and HSE Publication L143.

The Principal Designer requires evidence of air tightness certification for any enclosures required during removal, evidence of all transfer notes to a suitable registered tip (together with the details of a registered carrier) together with evidence of site clearance certification on completion of all asbestos

Due to the survey being limited to those areas accessible at the time of the survey, caution must be given to the full extent and nature of asbestos contamination. The Principal Contractor must put in place a protocol for dealing with contaminates found during the works that are not listed or fully identified within the reports.

The Registered Asbestos Contractor must provide to the Principal Designer evidence of air tightness certification for any enclosures required during removal, evidence of all transfer notes to a suitable registered tip (together with the details of a registered carrier) together with evidence of site clearance certification on completion of all asbestos removal for retention and inclusion within the Health & Safety File.

3.2.1.2 Storage on Site

The building was formally used as an MOT testing station. The Calabrian report highlights the presence of an above ground oil tank noted on the site. HazChem signs indicate that petrol and diesel may also have been stored in this area.

The Principal Contractor must ensure procedure are in place in the event of encountering hazardous substances during the works and ensure if required, the removal of all hazardous substances is in accordance with the Control of Substances Hazardous to Health Regulations (COSHH)

Procedures to be considered for the removal of any Oil tanks belonging to the former occupants of the building, prior to the commencement of this project. Particular caution is to be observed as within the site close by is an external area where oil traps/trays and 200 litre plastic drums (unknown contents) have been identified. .

Procedures to be considered for the investigation of the presence of pests, vermin, insects, etc, especially as the buildings have been left unoccupied prior to the commencement of this project. If appropriate contact the relevant specialist/authority to arrange safe eradication.

The PC must liaise with the Client to ensure any known hazardous materials on site are highlighted as required. There is a potential for cleaning products and commercial waste being store on site that may be considered hazardous, and the PC will need to be aware of these areas and implement control measures as required.

3.2.1.3 Hazardous / Fragile Materials

The Principal Contractor is to ensure that all existing glass and windows are either protected or removed in whole panes as and when appropriate prior to the demolition works, to prevent accidental cuts and abrasions.

3.2.1.4 Boilers, Storage Tanks, Pipework

Consider preparing specific risk assessments and method statements for dismantling, removing and disposing of the above, taking into account: presence of residual products of combustion, legionella and possibility of toxic fumes if galvanised tanks or pipes require cutting.

The risk of being exposed to Legionella is mainly during refurbishment and demolition work. The risks are linked to:

- *water stored or stagnating and re-circulated at temperatures between 20–45 °C – e.g. redundant parts of water systems or water storage tanks where the water is not frequently replaced.*
- *sources of nutrients such as rust, sludge, scale and organic matter*
- *production of contaminated water droplets / aerosol spray*
- *workers, visitors etc who are more susceptible to infection due to age, illness, a weakened immune system etc.*

3.2.1.5 Light Fittings

The removal and disposal of existing light fittings should provide procedures to account for the carcinogenic properties of PCB's and the requirements for safe handling and disposal of fluorescent tubes prior to any demolition works commencing

3.2.1.6 Dust

It is likely that dust will be created by the construction activities. Dust should be monitored by the PC throughout the demolition process

In accordance with the CDM Regulations 2015, the demolition or dismantling must be planned and carried out in a such a manner as to prevent danger or, where it Is not practicable to prevent it, to reduce danger to as low as reasonably practicable. The arrangements for carrying out such demolition must be recorded in writing before the demolition or dismantling work begins

Prior to the commencement of demolition at a plot of development, a detailed construction demolition management plan outlining working practices for that plot of development shall be submitted to and approved in writing by the Local Planning Authority.

The construction management plans shall include:

- Display of an emergency contact number;
- Communication strategy with residents;
- Details of Wheel Washing;
- Dust suppression measures;
- Compound locations where relevant;
- Location, removal and recycling of waste;

Limiting the escape of dust and debris during the demolition shall also be incorporated into the plan of works, to protect those that may be affected by the demolition work. The use of hoarding to control dust, water suppression techniques and soft stripping can be considered for use if appropriate.

The PC should reduce the dust exposure on site by utilising dust suppression or on tool extraction (Class M minimum) as well as implementing suitable respiratory protective equipment (RPE).

The RPE must be a minimum of FFP3, face fitted and the operative clean shaven within 8 hours of their shirt if this cannot be achieved full face mask RPE should be used..

The PC should consider alternative methods to reduce or eliminate the dust volume on site and potential exposure to the contractors.

The PC should also review COSHH information for products selected to highlight the exposure levels of the product and ensure alternate less harmful materials have been identified and considered

3.2.2 CONTAMINATED LAND

The Principal Contractor must ensure they undertake suitable investigations to highlight the potential of contaminated land and refer to the Calabrian report located within Appendix B

The Principal Contractors must also ensure arrangements are in place in the event contaminated land is encountered during the works and also this is highlighted during inductions and TBT

Guidance on contaminated ground is given in the Health and Safety Executive (HSE) document “Protection of Workers and the General Public during the redevelopment of Contaminated Land”. In summary the following measures are suggested to be provide a minimum level of protection:

All ground workers should be issued with relevant protective clothing, footwear and gloves. These protective items should not be removed from site and personnel should be instructed as to why and how they are used.

Hand –washing and boot-washing facilities should be provided.

Care should be taken to minimise the potential for off-site migration of contamination by the provision of dust suppression control and wheel cleaning equipment during the construction works.

Good practices relating to personal hygiene should be adopted on the site. All references and potential hazards and risks pertaining to the contamination shown in the ground report are noted and highlighted in section 3.1.6.

3.2.3 HEALTH RISKS FROM PREVIOUS USAGE AND CLIENT ACTIVITIES

Due to the previous building usage the PC must ensure all management controls are highlighted within their CPP and emergency arranged should any hazardous substances be encountered during the demolition works By-product of previous usage.

No additional risk have been identified to date other than those included with this plan and the Tender and Contract Documents.

3.3 OTHER ENVIRONMENTAL CONSTRAINTS

3.3.1 EXISTING ON OR ADJACENT TO SITE

Environmental issues have been highlighted in surveys and reports on the existing environment however the Principal Contractor must ensure that all risk assessments and method statements prepared include safe management of any issues listed below that may be affected by the works and protects the environment wherever possible.

- Close Pproxininty to residential, commercial and student accommodation
- Congested area in relation to vehicle and pedestrian movement
- Restricted access around the site
- TPOs – Hedgerows etc - protection of trees and possible nesting birds.
- Flood Risk– Ponds – possibility of rats on site and increased risk of Weil's Disease (leptospirosis), therefore particular attention to disposal of food rubbish on site and personal hygiene.
- Bats – Badgers – Newts etc – protection, exclusion, time restrictions for works.
- Rare plants to be protected, invasive plants to be eradicated and special provisions for the works.
- Footpaths – Bridleways etc - Public access, public protection, site security.
- Archaeological issues exist but this generally entails a watching brief which should not impact unduly on this development, however the Principal Contractor has a responsibility to ensure that any archaeologists on site are fully conversant with health and safety requirements and have been inducted on their first visit to site.

3.3.2 RESULTING FROM CONSTRUCTION WORKS

3.3.2.1 Noise

Consideration must be given to ensure minimal disruption is caused to the occupants and nearby premises. The Principal Contractor should liaise with adjacent and surrounding buildings to show consideration and make every effort to reduce noise during peak times. Key operations must be identified which are likely to cause higher noise levels and these dates are to be given to the adjacent users to reduce disruption.

The Principal Contractor shall make every effort, as far as is reasonably practicable, to minimise noise levels and nuisance when carrying out the works. Noise levels from the works are to be kept below 85 dB(A) when measured from the site boundary, or at levels set by the planning conditions. Noise should be minimised by adequate means set out in The Control of Noise at Work Regulations 2005 which may include acoustic hoarding, selection, use and maintenance, of plant and equipment etc.

The Principal Contractor should request from their contractors noise ratings of all plant and machinery, including hand held power tools and keep the records in their Construction Phase Plan. This will enable the Principal Contractor to identify all activities, which are shared and exceed the noise action levels as defined by GE 700 (Construction Site Safety – Control of Noise). Where applicable these have been communicated to all Supply Chain contractors.

3.3.2.2 Vibration

Contractors are to carry out vibration risk assessments for all operations that are identified as exposing their employees to vibration. The Control of Vibration at Work Regulations specifies Exposure Action and Exposure Limit Values. The Principal Contractor should ensure that all risk assessments adequately consider the effects of vibration and that suitable controls are included in the corresponding method statements to manage and reduce those effects. The Method Statements should include controls to reduce individuals' exposure to vibration so that the Exposure Action Value

is not exceeded. Contractors are not to expose their operatives to vibration that exceeds the Exposure Limit Value.

3.3.2.3 Dust

Given the nature of the works and location the contractor will be required to identify all of their dust mitigation controls to ensure that no dust will enter into the adjacent building areas or air intake systems,

It is likely that dust will be created by various construction activities, especially during dry and windy conditions on the site. Dust should be monitored through the site inspection process. The Principal Contractor should reduce the dust exposure as far as reasonably practicable by means of reviewing the methodology of the demolition process to ensure, on tool extraction (Class M), water suppression and contractor RPE

4.0 SIGNIFICANT DESIGN AND CONSTRUCTION HAZARDS

4.1 SIGNIFICANT DESIGN ASSUMPTIONS AND SUGGESTED WORK METHODS, SEQUENCES OR OTHER CONTROL MEASURES

Where possible significant hazardous work methods or sequences have been designed out. However some risks remain and as such are to be identified within the overall assessment. The designers will also provide sufficient information to alert others to the inherent risk in the design and provide others, dependent on it, with that information which they cannot reasonably be expected to know. Any / all significant construction risks associated with the design are to be highlighted on their Design Risk Register. Information available at the time of issue of this pre construction information is included in **Appendix C.**

The following significant hazardous work methods / sequences highlighted in this plan and on the Design Risk Assessments will require management on site

- Protection of the edges of all excavations and taking adequate precautions with deep excavations.
- Lifting heavy materials and equipment e.g. P C kerbs, drainage rings etc.
- Appropriate management and operational systems specific to the works that are to take place on the public roads, to ensure safe management of public traffic and adequate segregation of works from the public thus ensuring safety of both site operatives and the general public.
- Assess risks associated with site wide implication for traffic and emergency procedures draw up detailed Fire and Traffic Management Procedures, Emergency Plans, programmed Craneage and delivery schedules as appropriate.
- Consideration given to the build sequence and erection of scaffolding due to: - proximity of adjacent units (gables); restricted clearance between front elevation of houses and roads, and need to ensure safe access for residents of completed units.
- Consideration should be given to the early delivery and storage on site within the building footprint (at first and second floor levels) heavy and awkward items such as stair cases, pre glazed windows, fire doors and boilers to allow these items to be craned in and stored / installed prior to the envelope being fully enclosed and providing only limited access and manoeuvrability.
- Crane control – lifting plan, appointed person in charge, suitability of crane, segregation of work area and area below jib / material path etc.

4.2 ARRANGEMENTS FOR CO-ORDINATION OF ONGOING WORK DESIGN WORK AND HANDLING DESIGN CHANGES

Each element of design, including temporary works, designed access equipment, individual specialist contractors and specialist designer packages, is required to be developed with due consideration for the health and safety of all concerned both during construction and subsequent occupancy and maintenance. To facilitate this the following shall apply:-

- The Principal Contractor shall ensure that any designer appointed by them shall be provided with all necessary information to enable the design to take into account other works and other design elements in selecting the most appropriate options.
- Each element of the design shall be developed by the designer on the basis of risk assessments regarding: execution, maintenance, repair and subsequent demolition and dismantling.
- Each element of the design shall be submitted in sufficient time to permit proper consideration of health and safety and review of the design itself.
- The Principal Contractor shall be required to update, amend and modify the detailed Construction Plan to address any health and safety risk associated with individual design elements developed during the works.

Regular progress meetings will be held on site following an agreed agenda to include Design and Health and Safety considerations. The frequency, agenda and form of the meeting is to be agreed at the start of the construction period.

This development is part of a consortium site; meetings are to be held between all parties concerned, as directed by the 'lead' Contractor. Frequency, agenda and form of meeting are to be discussed and agreed between all parties. Notes and minutes of all consortium meetings shall be filed in the Principal Contractor's Construction Phase Plan. Relevant exchanges of information should be included within progress meetings and communicated to site operatives where any changes affect working on site.

4.3 INFORMATION ON DESIGN RISKS IDENTIFIED DURING DESIGN

As part of their duties, the designer shall ensure that where possible, significant construction health and safety risks have been designed out. However where significant risks remain they are to be reviewed, identified and communicated to others as described in section 4.1 above.

The Residual Risk Register is to be issued to the Principal Designer and other design team members during the design period and to the Principal Contractor with drawings for tendering purposes.

The following significant construction risks highlighted in this plan and on the Design Risk Assessments may require specific method statements from either the Principal Contractor or their specialist contractors and will require management on site:

- Excavations in contaminated ground – although remediation has been carried out, excavations may temporarily expose additional contamination, therefore specific risk assessments, and method statements will be required stating precautions to be used – wearing PPE, limiting exposure times.
- Deep trench excavation – including additional risks of stability and working in confined spaces, consider using Permit to Work system for works in excavations, ensure stability by use of temporary strutting if necessary.
- Stability of building during demolition process– ensure that additional bracing and support is used, if necessary until full structural strength and stability attained – partly completed buildings should not be overloaded with materials to be used in the construction.

- Working at Heights – working at ground level adjacent to excavations could be considered to be 'working at height' in respect that site operatives may be at risk of falling and being injured. Therefore all excavations are to be protected with suitable barriers when necessary to prevent this. Traditional work at height includes roof works such as erection and bracing of roof trusses, erection and fitting of GRP chimneys, suitable precautions to prevent operatives falling and being injured are to be considered and implemented where necessary.
- Hot Works – including welding leadwork and working with hot bitumen – use Permit to Work system for all hot works.

4.4 MATERIALS REQUIRING PARTICULAR PRECAUTIONS

Although it is not anticipated that unusual materials will be specified, all designers should, within the Design Risk Register, provide details of the significant risks associated with the use of specified materials and substances.

Each contractor should provide COSHH assessments and product information for control of any materials and or substances specified within the construction carrying foreseeable significant potential hazards and / or requiring particular management methods i.e. wearing specialised PPE, use in well-ventilated areas, fire precautions for flammable substances etc.

COSHH assessments and product data for any materials incorporated into the final structure that carry on-going risks for, or require particular precautions by, persons engaged in maintenance, repair and subsequent demolition and dismantling works, must be passed to the Principal Designer for inclusion in the Health and Safety File.

5.0 HEALTH AND SAFETY FILE

5.1 HEALTH AND SAFETY FILE FORMAT

The following is the standard format recommended by CDM 2015

- A brief description of the work carried out.
- Any residual hazards which remain and how they are dealt with (for example surveys or other information concerning asbestos, contaminated land, water bearing strata, buried services etc).
- Key structural principles (for example, bracing, sources of substantial stored energy – including pre and post-tensioned members) and safe working loads for floors and roofs, particularly where these may preclude placing scaffolding or heavy machinery there.
- Hazardous materials used (for example lead paint, special coatings which should not be burnt off etc).
- Information regarding the removal or dismantling of installed plant and equipment (for example any special arrangements for lifting, order or other special instructions for dismantling etc).
- Health and safety information about equipment provided for cleaning or maintaining the structure.
- The nature, location and markings of significant services, including underground cables; gas supply equipment; fire-fighting services etc.
- Information and as-built drawings of the structure, its plant and equipment (for example the means of safe access to and from service voids, fire doors and compartmentalisation etc).

5.2 HEALTH & SAFETY FILE PROGRAMME

The File information is to be collated during the design and construction period, the programme for production of information is to be discussed and agreed with the Principal Designer.

APPENDIX A:
HSE F10 NOTIFICATION

Notification of construction project

Created Date: 14/05/2025

About the location of the site

Address of the construction site	53-57 UPPER BROOK ST, MANCHESTER , MANCHESTER, ENGLAND, M13 9QD
In which local authority is the site address?	Manchester City Council

About the project

Description of project	Demolition and Dismantling: Dem/Dis - Other, Groundworks: Groundworks - Other, Other: Not known, Road and Path Maintenance: Road & Path Maint., Site Investigation: Site investigation, Utilities Work: Utilities Work
Description of the construction work	The enabling works consist of HV diversion works, demolition of the exiting building situated on the site, bulk excavations and reduced level dig along with the associated site clearance activities. The enabling works forms part of the wider Upper Brook Street Masterplan.
No of people on site	50
No of contractors on site	5
Start Date	15/05/2025
Time Allowed by Client (in weeks)	20
Duration (in weeks)	17

About those involved in the project

Name	[redacted]
Email	
Address	
Name	
Email	
Address	
Name	

Email	
Address	

Declaratio

Name	
Declaration	
Date	
Confirmation	



Client Signature (Can be used for your own records, ONLY if required)

Declaration (as stated above)

Name:

Declaration Signature:

Date:

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APPENDIX B:
DOCUMENTS SUPPORTING THE PCI

7293/011/RJH/rjh

18th November 2024

Mr D Richards
McLaren Property Limited
McLaren House
6090 Knights Court
Birmingham Business Park
Birmingham
B37 7WY

Dear David

Upper Brook Street, Manchester M13 9QD - Hazardous Gas Risk Assessment

Further to our Geoenvironmental Appraisal Report (No. 7293/1, dated June 2024), gas monitoring at the above site has now been completed and we are able to issue this supplementary letter report together with copies of the monitoring results. This letter, which should be read in conjunction with Report No 7293/1, reviews soil-gas conditions, assesses risks and details any mitigation measures required to render the site suitable for the proposed development.

Background

The site is located approximately 1.5km south-east of Manchester City Centre and comprises a former Citroen car dealership, MOT testing and servicing centre. A single storey brick and steel clad apparently steel framed building lies in the central area of the site.

The western section of the building comprises the former showroom with first floor offices whilst the eastern section housed workshops used for servicing and vehicle testing. The building has a concrete floor, and vehicles were accessed via hydraulic lifts rather than pits.

External areas are all tarmac surfaced. In the north lies a small lean-too building formerly used for car cleaning and valeting.

Consideration of the conceptual site model and potential linkages has enabled a preliminary qualitative assessment of risks associated with gas:

Source	Receptors	Hazard	Pathway	Initial Risk
On-site and possible off-site made ground	Human Health	Asphyxiation & explosion.	Vertical migration, ingress & accumulation	**Very Low**: made ground essentially inert, with little degradable matter.

Given the above, gas monitoring wells have been installed in four shallow boreholes across the site. Details of the individual installations are provided in Report No 7293/1.

Consideration is being given to redevelopment of the site with two blocks of student accommodation of twenty-two and eleven storeys with a single storey podium linking them together. A proposed site layout has been provided by McLaren and is copied as Drawing 7293/2 in Report No 7293/1.

The structures will be founded on or in the Chester Formation sandstone at depth either on deep pad or short piled foundations.

Scope of Works

The generation potential of the gas source was initially considered to be Low and this has been confirmed by the monitoring results obtained. Consequently, in accordance with CIRIA Report C665, given the proposed residential end use, six visits have been completed over a six month period, between May and October 2024.

A standard procedure was followed in accordance with CIRIA guidance; this procedure involved measurement, in the following order of:

- Atmospheric temperature, pressure and ambient oxygen concentration on site immediately prior to and on completion of monitoring;
- methane, oxygen and carbon dioxide concentrations and flow rates using a Geotechnical Instruments GA5000 infra-red gas analyser; and,
- standing water level using a dipmeter.

Gas Monitoring Results

The monitoring results are enclosed and summarised below:

Monitoring Well	Response Zone	Range of Methane Concentrations (% v/v)	Range of Carbon Dioxide Concentrations (% v/v)	Range of Steady Flow Rates (litre/hour)
BH101	1.0m to 3.7m (Glacial Deposits)	0.0 to 0.1	0.0 to 1.1	0.1 to 0.4
BH103	1.0m to 3.0m (Glacial Deposits)	0.0	0.0 to 2.1	0.1 to 0.5
BH104	1.0m to 3.0m (Glacial Deposits)	0.0	0.4 to 8.7	0.1 to 0.5
BH106	1.0m to 3.0m (Glacial Deposits)	0.0 to 1.1	2.6 to 13.5	0.1 to 0.4

Note: Atmospheric pressures varied between 990mb and 1066mb.

In accordance with the DETR approach, a default value of 0.1 litres/hour has been used in the absence of any recorded flows; i.e. the limit of detection of the flow rate equipment.

During four of the six monitoring visits, atmospheric pressure was falling, including one where the pressure was below 1000mb. Plots of atmospheric pressure versus time, with the monitoring visits indicated, are appended to this letter report.

Current Gas Regime

The proposed student residential redevelopment comprises two blocks of twenty-two and eleven storeys. Consequently, the gas regime has been characterised in accordance with the Situation A (Wilson & Card) methodology outlined in CIRIA Report C665.

Based on worst-case gas concentrations and flows, Gas Screening Values (GSVs) for Methane and Carbon Dioxide are 0.01 and 0.07 respectively. These GSVs equate to CHARACTERISTIC SITUATION 1 (CS1).

However, giving consideration to additional factors, most notably elevated concentrations of carbon dioxide (up to 13.5%), suggests the site's classification should be raised to CHARACTERISTIC SITUATION 2 (CS2).

Protection Measures

Based on the site characterisation discussed above, the proposed foundation solution, and with reference to the gas protection "scoring" system outlined in BS 8485:2015 + A1:2019 for Building Type B[1], Calabrian consider that the following protective measures should be incorporated in all new structures:

Characteristic Situation (Wilson & Card, 1999)	Gas "score" req'd by BS 8485	Protective Measures		
		Floor Slab (BS8485 "score")	Sub-floor ventilation (BS8485 "score")	Membrane Type (BS8485 "score")
2	3.5 (Type B)	'Beam and Block' segmental suspended subfloor – **(0)**. Reinforced ground bearing slab – **(0.5)**. Reinforced, cast in-situ suspended slab (well reinforced with minimal service penetrations & water bars around all slab penetrations & at joints) – **(1.5)**. Basement floor and walls conforming to BS8102:2009, Grade 2 waterproofing – **(2.0)**. Basement floor and walls conforming to BS8102:2009, Grade 3 waterproofing – **(2.5)**.	Layer of low permeability and/or is not terminated in a venting trench (or similar). **(0)** Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building) - **(0.5)**. For smaller commercial units, passive sub-floor ventilation; venting layer could be: i. A min. 200mm clear void **(2.5)**, or ii. A proprietary void former (expanded polystyrene shuttering) providing an equivalent clear void depth of 60mm **(2.5)**, or iii. Min. 300mm thick blanket of 20mm single size gravel, not MOT Type 1 **(0.5)**. Min. ventilation = 2,500 mm^2/m run of external wall (via air bricks on each of 2 opposite sides), with 100mm pipes at 2m centres or honeycombing of any sub-floor sleeper walls.	Gas resistant membrane meeting criteria of Table 7 BS8485:2019 with verification in accordance with CIRIA C735 [N1]. **(2.0)** ***Vented CS2 this will comprise independent visual inspection. ***Unvented this will comprise independent visual inspection and air lance integrity testing.

[1] ***Type B building***: *private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.*

Should you require any further information, please contact the undersigned.

[redacted]

enc

Hazardous Gas Monitoring Results
Plot of Atmospheric Pressure Trend
Gas Monitor Calibration Certification

calabrian

Calabrian Limited
9 Millwood | Ingleton | LA6 3HY | Tel: 07957 335307
email: info@calabrian.co.uk

GAS & GROUNDWATER MONITORING

Project Name	Upper Brook Street, Manchester M13 9QD
Project Number	7293
Client	Mclaren Property
Date	20/05/2024
Start/Finish Time	09:10 - 09:45
Operator	RJH

Weather	
Raining/Dry	Dry
Cloud Cover (%)	10
Temperature (°C)	16
Pressure (mb)	1008
Weather Station Trend	Falling

Key	
ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

Monitoring Point	Base of well	Groundwater level	Concentrations					Gas Flow Rates			Remarks
			Initial / Highest		Steady		Lowest	Initial / Maximum	Steady	Time to fall from highest to steady	
			CH_4	CO_2	CH_4	CO_2	O_2				
	m	(m) bgl	% v/v	(%)	% v/v	(%)	(%)	litre/hr	litre/hr	secs	
BH101		Dry	0.0	0.1	0.0	0.1	21.0	0.4	0.4		
BH103		Dry	0.0	2.1	0.0	2.1	19.0	0.5	0.5		
BH104		Dry	0.0	0.4	0.0	0.4	20.5	0.5	0.5		
BH106		Dry	0.0	2.6	0.0	2.6	16.6	0.4	0.4		

Equipment:
Gas Data GFM430 Infrared Gas Analyser
Geotechnical Instruments Dipmeter

	CH_4	CO_2	O_2
Trigger level 1	1	5	16
Trigger level 2	5	10	10

GAS & GROUNDWATER MONITORING

Project Name	Upper Brook Street, Manchester M13 9QD
Project Number	7293
Client	Mclaren Property
Date	14/06/2024
Start/Finish Time	1110 - 1125
Operator	RJH

Weather	
Raining/Dry	Damp
Cloud Cover (%)	80
Temperature (°C)	16
Pressure (mb)	990
Weather Station Trend	Falling

Key	
ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

Monitoring Point	Base of well	Groundwater level	Concentrations					Gas Flow Rates			Remarks
			Initial / Highest		Steady		Lowest	Initial / Maximum	Steady	Time to fall from highest to steady	
			CH_4	CO_2	CH_4	CO_2	O_2				
	m	(m) bgl	% v/v	(%)	% v/v	(%)	(%)	litre/hr	litre/hr	secs	
BH101		Dry	0.0	0.1	0.0	0.1	21.0	0.1	0.1		
BH103											No access within the building.
BH104		Dry	0.0	3.6	0.0	3.6	18.6	0.2	0.2		
BH106		Dry	0.0	4.6	0.0	4.6	17.9	0.1	0.1		

Equipment:
Gas Data GFM430 Infrared Gas Analyser
Geotechnical Instruments Dipmeter

	CH_4	CO_2	O_2
Trigger level 1	1	5	16
Trigger level 2	5	10	10

GAS & GROUNDWATER MONITORING

Project Name	Upper Brook Street, Manchester M13 9QD
Project Number	7293
Client	Mclaren Property
Date	27/07/2024
Start/Finish Time	1435 - 1455
Operator	RJH

Weather	**Start**
Raining/Dry	Dry
Cloud Cover (%)	10
Temperature (°C)	18
Pressure (mb)	1006
Weather Station Trend	Rising

Key	
ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

Monitoring Point	Base of well	Groundwater level	Concentrations					Gas Flow Rates			Remarks
			Initial / Highest		Steady		Lowest	Initial / Maximum	Steady	Time to fall from highest to steady	
			CH_4	CO_2	CH_4	CO_2	O_2				
	m	(m) bgl	% v/v	(%)	% v/v	(%)	(%)	litre/hr	litre/hr	secs	
BH101		Dry	0.0	0.3	0.0	0.3	20.1	0.1	0.1		
BH103											No access within the building.
BH104		Dry	0.0	**5.2**	0.0	**5.2**	17.2	0.1	0.1		
BH106		Dry	0.0	**10.1**	0.0	**10.1**	**8.2**	0.1	0.1		

Equipment:
Gas Data GFM430 Infrared Gas Analyser
Geotechnical Instruments Dipmeter

	CH_4	CO_2	O_2
Trigger level 1	1	5	16
Trigger level 2	5	10	10

GAS & GROUNDWATER MONITORING

Project Name	Upper Brook Street, Manchester M13 9QD
Project Number	7293
Client	Mclaren Property
Date	24/08/2024
Start/Finish Time	1050 - 1115
Operator	RJH

Weather	**Start**
Raining/Dry	Rain
Cloud Cover (%)	100
Temperature (°C)	15
Pressure (mb)	996
Weather Station Trend	Rising

Key	
ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

Monitoring Point	Base of well	Groundwater level	Concentrations					Gas Flow Rates			Remarks
			Initial / Highest		Steady		Lowest	Initial / Maximum	Steady	Time to fall from highest to steady	
			CH_4	CO_2	CH_4	CO_2	O_2				
	m	(m) bgl	% v/v	(%)	% v/v	(%)	(%)	litre/hr	litre/hr	secs	
BH101		Dry	0.0	1.1	0.0	1.1	17.3		0.0		
BH103											No access within the building.
BH104		Dry	0.0	**8.8**	0.0	**8.7**	10.3		0.2		
BH106		Dry	**1.1**	**13.5**	**1.1**	**13.5**	**2.2**		0.0		

Equipment:
Gas Data GFM430 Infrared Gas Analyser
Geotechnical Instruments Dipmeter

	CH_4	CO_2	O_2
Trigger level 1	1	5	16
Trigger level 2	5	10	10

GAS & GROUNDWATER MONITORING

Project Name	Upper Brook Street, Manchester M13 9QD
Project Number	7293
Client	Mclaren Property
Date	20/09/2024
Start/Finish Time	1500 - 1520
Operator	RJH

Weather	**Start**
Raining/Dry	Dry
Cloud Cover (%)	0
Temperature (°C)	15
Pressure (mb)	1015
Weather Station Trend	Falling

Key	
ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

Monitoring Point	Base of well	Groundwater level	Concentrations					Gas Flow Rates			Remarks
			Initial / Highest		Steady		Lowest	Initial / Maximum	Steady	Time to fall from highest to steady	
			CH_4	CO_2	CH_4	CO_2	O_2				
	m	(m) bgl	% v/v	(%)	% v/v	(%)	(%)	litre/hr	litre/hr	secs	
BH101		Dry	0.0	0.9	0.0	0.9	19.2		0.0		
BH103											No access within the building.
BH104		Dry	0.0	**6.1**	0.0	**6.1**	10.3		0.2		
BH106		Dry	0.0	**9.2**	0.0	**9.2**	**6.4**		0.0		

Equipment:
Gas Data GFM430 Infrared Gas Analyser
Geotechnical Instruments Dipmeter

	CH_4	CO_2	O_2
Trigger level 1	1	5	16
Trigger level 2	5	10	10

GAS & GROUNDWATER MONITORING

Project Name	Upper Brook Street, Manchester M13 9QD
Project Number	7293
Client	Mclaren Property
Date	24/10/2024
Start/Finish Time	1350 - 1410
Operator	RJH

Weather	**Start**
Raining/Dry	Dry
Cloud Cover (%)	10
Temperature (°C)	14
Pressure (mb)	1066
Weather Station Trend	Falling

Key	
ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

Monitoring Point	Base of well	Groundwater level	Concentrations					Gas Flow Rates			Remarks
			Initial / Highest		Steady		Lowest	Initial / Maximum	Steady	Time to fall from highest to steady	
			CH_4	CO_2	CH_4	CO_2	O_2				
	m	(m) bgl	% v/v	(%)	% v/v	(%)	(%)	litre/hr	litre/hr	secs	
BH101		Dry	0.1	0.3	0.1	0.3	20.2				
BH103											No access within the building.
BH104		Dry	0.0	**6.9**	0.0	**6.9**	10.3				
BH106		Dry	0.1	**11.5**	0.0	**11.5**	**4.7**				

Equipment:
Gas Data GFM430 Infrared Gas Analyser
Geotechnical Instruments Dipmeter

	CH_4	CO_2	O_2
Trigger level 1	1	5	16
Trigger level 2	5	10	10

SUMMARY OF HAZARDOUS GAS MONITORING RESULTS

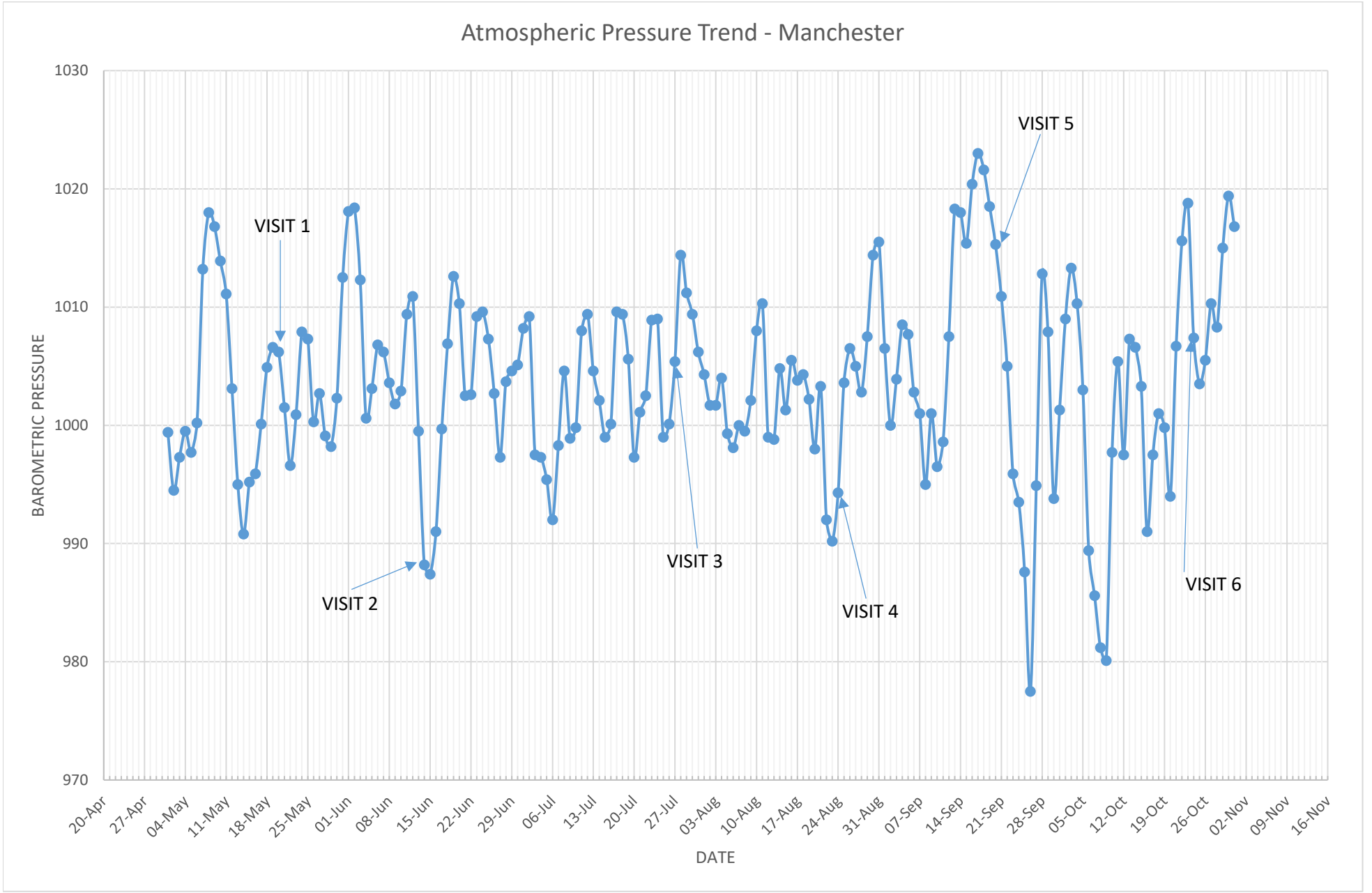
Max. recorded steady concentration of methane (any borehole)	1.1	%
Max. recorded steady concentration of carbon dioxide (any borehole)	13.5	%
Max. recorded peak concentration of methane (any borehole)	1.1	%
Max. recorded peak concentration of carbon dioxide (any borehole)	13.5	%
Max. recorded peak gas flow (any borehole)	0.5	l/hr (default 0.1)
Max. recorded steady gas flow (any borehole)	0.5	l/hr (default 0.1)
Site GSV for methane (based on peak flows & peak concentrations)	0.01	litre/hr
Site GSV for carbon dioxide (based on peak flows & peak concentrations)	0.0675	litre/hr
Site GSV for methane (based on steady flows & peak concentrations)	0.0055	litre/hr
Site GSV for carbon dioxide (based on steady flows & peak concentrations)	0.0675	litre/hr
Max. recorded GSV for methane in any one borehole	0.0044	litre/hr
Max. recorded GSV for carbon dioxide in any one borehole	0.0540	litre/hr

CLASSICATION	
C665 Traffic Light	
AMBER1	
AMBER2	
AMBER1	
AMBER2	
	Wilson & Card
GREEN	CS1
GREEN	CS1
GREEN	CS1
GREEN	CS1
GREEN	CS1
GREEN	CS1

Barometric Pressure		
Visit	Average	Trend
Visit 1	1008	Falling
Visit 2	990	Falling
Visit 3	1006	Rising
Visit 4	996	Rising
Visit 5	1015	Falling
Visit 6	1066	Falling

Visit	Exp Hole	GWL	Concentrations					Gas Flow Rates			Gas Screening Value (GSV)		Surface Gas Emission Rate	
			Initial\Highest		Steady		Lowest O_2	Initial	Steady	Time to fall from highest to steady	CO_2	CH_4%V/V	CO_2	CH_4%V/V
			CH_4 (% v/v)	CO_2 (%)	CH_4 (% v/v)	CO_2 (%)	(%)	(litre/hr)	(litre/hr)	(secs)	(litre/hr)	(litre/hr)	($m^3/m^2/hr$)	($m^3/m^2/hr$)
											Diameter of monitoring well (mm)			50
Visit 1	BH101	Dry	0.0	0.0	0.0	0.0	21.0	0.4	0.4	0.0				
Visit 2	BH101	Dry	0.0	0.1	0.0	0.1	21.0	0.1	0.1	0.0				
Visit 3	BH101	Dry	0.0	0.3	0.0	0.3	20.1	0.1	0.1	0.0				
Visit 4	BH101	Dry	0.0	1.1	0.0	1.1	17.3	0.1	0.1	0.0				
Visit 5	BH101	Dry	0.0	0.9	0.0	0.9	19.2	0.1	0.1	0.0				
Visit 6	BH101	Dry	0.1	0.3	0.1	0.3	20.2	0.1	0.1	0.0				
											Diameter of monitoring well (mm)			50
Visit 1	BH103	Dry	0.0	2.1	0.0	2.1	19.0	0.5	0.5	0.0				
Visit 2	BH103	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0				
Visit 3	BH103	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0				
Visit 4	BH103	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0				
Visit 5	BH103	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0				
Visit 6	BH103	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0				
	Max	0.0	0.0	2.1	0.0	2.1	19.0	0.5	0.5		0.0105	0.0000	1.05E-06	0.00E+00

Visit	Exp Hole	GWL	Concentrations					Gas Flow Rates			Gas Screening Value (GSV)		Surface Gas Emission Rate	
			Initial\Highest		Steady		Lowest O_2	Initial	Steady	Time to fall from highest to steady				
			CH_4 (% v/v)	CO_2 (%)	CH_4 (% v/v)	CO_2 (%)	(%)	(litre/hr)	(litre/hr)	(secs)	CO_2 (litre/hr)	CH_4%V/V (litre/hr)	CO_2 ($m^3/m^2/hr$)	CH_4%V/V ($m^3/m^2/hr$)
											Diameter of monitoring well (mm)			50
Visit 1	BH104	Dry	0.0	0.4	0.0	0.4	20.5	0.5	0.5	0.0				
Visit 2	BH104	Dry	0.0	3.6	0.0	3.6	18.6	0.2	0.2	0.0				
Visit 3	BH104	Dry	0.0	5.2	0.0	5.2	17.2	0.1	0.1	0.0				
Visit 4	BH104	Dry	0.0	8.8	0.0	8.7	10.3	0.1	0.2	0.0				
Visit 5	BH104	Dry	0.0	6.1	0.0	6.1	10.3	0.1	0.2	0.0				
Visit 6	BH104	Dry	0.0	6.9	0.0	6.9	10.3	0.1	0.1	0.0				
	Max		0.0	0.0	8.8	0.0	8.7	20.5	0.5	0.5	0.0440	0.0000	4.40E-06	0.00E+00
											Diameter of monitoring well (mm)			50
Visit 1	BH106	Dry	0.0	2.6	0.0	2.6	16.6	0.4	0.4	0.0				
Visit 2	BH106	Dry	0.0	4.6	0.0	4.6	17.9	0.1	0.1	0.0				
Visit 3	BH106	Dry	0.0	10.1	0.0	10.1	8.2	0.1	0.1	0.0				
Visit 4	BH106	Dry	1.1	13.5	1.1	13.5	2.2	0.1	0.1	0.0				
Visit 5	BH106	Dry	0.0	9.2	0.0	9.2	6.4	0.1	0.1	0.0				
Visit 6	BH106	Dry	0.1	11.5	0.0	11.5	4.7	0.1	0.1	0.0				
	Max		0.0	1.1	13.5	1.1	13.5	17.9	0.4	0.4	0.0540	0.0044	5.40E-06	4.40E-07


Atmospheric Pressure Trend - Manchester
BAROMETRIC PRESSURE
1030
1020
1010
1000
990
980
970
VISIT 1
VISIT 2
VISIT 3
VISIT 4
VISIT 5
VISIT 6
20-Apr
27-Apr
04-May
11-May
18-May
25-May
01-Jun
08-Jun
15-Jun
22-Jun
29-Jun
06-Jul
13-Jul
20-Jul
27-Jul
03-Aug
10-Aug
17-Aug
24-Aug
31-Aug
07-Sep
14-Sep
21-Sep
28-Sep
05-Oct
12-Oct
19-Oct
26-Oct
02-Nov
09-Nov
16-Nov
DATE

CERTIFICATION OF CALIBRATION

PJLA Calibration No. 66916

QED

Date Of Calibration: 15-Mar-2024

Certificate Number: G500452_9/34948

Issued by: QED Environmental Systems Inc.

Customer: **CALABRIAN LIMITED**
9 MILLWOOD INGLETON, LA6 3HY GB

Description:

Model: GA5000

Serial Number: G500452

Accredited Results:

Methane (CH4)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
5.1	5.0	0.42
15.0	14.9	0.66
60.0	59.8	1.03

Carbon Dioxide (CO2)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
5.0	5.0	0.43
15.2	15.1	0.71
40.0	40.1	1.19

Oxygen (O2)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
20.9	21.0	0.25

Gas cylinders are traceable and details can be provided if requested.

CH4, CO2 readings recorded at: 31.6 °C/88.8 °F

O2 readings recorded at: 22.3 °C/72.2 °F

Barometric Pressure: 0981 mbar/28.96 "Hg

Method of Test : The analyzer is calibrated in a temperature controlled chamber using a series of reference gases, in compliance with procedure ISP17.

Instrument has passed calibration as the measurement result is within the specification limit. The specification limit takes into account the measurement uncertainty.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with NIST requirements.

The calibration results published in this certificate were obtained using equipment capable of producing results that are traceable through NIST to the International System of Units (SI). Certification only applies to results shown. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

www.qedenv.com (800) 624-2026 info@qedenv.com

QED Environmental Systems Inc. 2355 Bishop Circle West, Dexter, MI 48130

CERTIFICATION OF CALIBRATION

PJLA Calibration
No. 66916

QED™

Date Of Calibration: 15-Mar-2024

Certificate Number: G500452_9/34948

Issued by: QED Environmental Systems Inc.

Non Accredited results:

Pressure Transducers (inches of water column)					
Transducer	**Certified (Low)**	**Reading (Low)**	**Certified (High)**	**Reading (High)**	**Accuracy**
Relative	0"	0"	40"	40.35"	2.0"

Barometer (mbar)	
Reference	**Instrument Reading**
0981 mbar / 28.96 "Hg	0982 mbar / 28.99 "Hg

Additional Gas Cells		
Gas	**Certified Gas (ppm)**	**Instrument Reading (ppm)**
CO	500	491
H_2S	252	252

As received gas check readings:

Methane (CH4)	
Certified Gas (%)	**Instrument Reading (%)**
5.1	6.1
15.0	16.7
60.0	63.6

Carbon Dioxide (CO2)	
Certified Gas (%)	**Instrument Reading (%)**
5.0	5.6
15.2	16.2
40.0	42.4

Oxygen (O2)	
Certified Gas (%)	**Instrument Reading (%)**
21.5	21.6

As received Gas readings recorded at: 31.6 °C/88.8 °F

As received Barometric Pressure recorded at: 22.3 °C/72.2 °F

As received gas check readings are only recorded if the instrument is received in a working condition. Where the instrument is received damaged no reading can be taken.

Date of Issue : 20 Mar 2024 Approved By Signatory

Chris Fleenor

The calibration results published in this certificate were obtained using equipment capable of producing results that are traceable through NIST to the International System of Units (SI). Certification only applies to results shown. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

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QED Environmental Systems Inc. 2355 Bishop Circle West, Dexter, MI 48130

INVESTIGATION TRENCH TO CONFIRM LOCATION OF EXISTING SERVICES AS SHOWN ON RECORD DRAWINGS

EXISTING SERVICES TO BE REMOVED IN THEIR ENTIRETY TO THE SITE BOUNDARY

INVESTIGATION TRENCH TO CONFIRM LOCATION OF EXISTING SERVICES AS SHOWN ON RECORD DRAWINGS

INVESTIGATION TRENCH TO CONFIRM LOCATION OF EXISTING SERVICES AS SHOWN ON RECORD DRAWINGS

6.6kV ELECTRICITY CABLE CROSSING SITE AND MAY REQUIRE DIVERSION

EXISTING SERVICE TO BE REMOVED IN THEIR ENTIRETY TO THE SITE BOUNDARY

INVESTIGATION TRENCH TO CONFIRM LOCATION OF EXISTING SERVICES AS SHOWN ON RECORD DRAWINGS

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INVESTIGATION TRENCH TO CONFIRM LOCATION OF EXISTING SERVICES AS SHOWN ON RECORD DRAWINGS

EXISTING SERVICE TO BE REMOVED IN THEIR ENTIRETY TO THE SITE BOUNDARY

EXISTING MOBILE TELECOMMUNICATION EQUIPMENT

6.6kV ELECTRICITY CABLE CROSSING SITE AND MAY REQUIRE DIVERSION

INVESTIGATION TRENCH TO CONFIRM LOCATION OF EXISTING SERVICES AS SHOWN ON RECORD DRAWINGS

Substation

KINCARDINE ROAD

WHITEKIRK CLOSE

UPPER BROOK STREET

COTTENHAM STREET

CABOT STREET

Car Showroom (Vacant)

Shed

Car Park Tarmac

Elizabeth Yorwood Court

Car showroom Canopy

KEY

- DISTRICT HEATING
- GAS LINE (LP MAINS)
- GAS LINE (MP MAINS)
- FIBRE OPTIC CABLE
- BT / OPENREACH
- VIRGIN MEDIA
- VODAFONE
- SKY
- NATIONAL GRID ELECTRICITY TRANSMISSION
- PRIVATE ELECTRICITY DUCTS
- ELECTRICITY NETWORK
- ELECTRICITY NETWORK 11KV
- ELECTRICITY NETWORK 33KV
- ELECTRICITY NETWORK 66KV
- ELECTRICITY NETWORK 132KV
- PRIVATE WATER MAINS
- MAINS WATER & FIRE HYDRANT
- UNIDENTIFIED SERVICES
- FIRE HYDRANT
- WASHOUT
- MANHOLE
- BOX / CHAMBER
- CABINET
- EXISTING SERVICE TO BE REMOVED IN ITS ENTIRETY
- PHASE 2 BOUNDARY
- SEARCH BOUNDARY
- INVESTIGATION TRENCH

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, STRUCTURAL ENGINEERS DRAWINGS & SPECIFICATIONS.
2. DO NOT SCALE FROM THIS DRAWING
3. ALL IDENTIFIED SERVICES ARE BASED ON THE INFORMATION RECEIVED FROM THE RELEVANT UTILITY COMPANIES RECORD DRAWINGS. THE ACTUAL POSITION MAY BE DIFFERENT FROM THOSE SHOWN ON THE PLAN. ACTUAL LOCATION OF SERVICES WILL REQUIRE VERIFICATION ON SITE PRIOR TO ANY WORKS BEING UNDERTAKEN ON SITE.
4. REFER TO CIVIL ENGINEERS DRAWING FOR INFORMATION ON EXISTING DRAINAGE AND SEWERS ETC IN THE AREA.

DRAWING NOT INTENDED FOR USE AS A RECORD OF EXISTING SERVICES AND SHOULD BE USED WITH CAUTION.

Revision	Description	Date
P01	FIRST ISSUE	13/05/24

Drawing Status: PRELIMINARY

tate — Building Services, Fire Engineering, Design & Sustainability, Commissioning, Commercial Engineering — commercial engineering of it's kind

Client: MODA

Project: UPPER BROOK STREET MANCHESTER

Title: PRELIMINARY SITE CONSTRAINTS DRAWING

Engr	Drawn	Chckd	Apprd	Date
WS	MM	WS	JL	07/05/2024

Cad File	Scale	Size
B1108-TCL-ZZ-ZZ-DR-ME-0701.DWG	1:250	A0

Drawing Number	Revision
B1108-TCL-ZZ-ZZ-DR-ME-0701	P01

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Geotechnical Engineering | Geoenvironmental Consultants



calabrian

REMEDIATION STRATEGY & VERIFIACTION PLAN

for land at

UPPER BROOK STREET, MANCHESTER, M13 9QD

Prepared on behalf of McLaren Property Limited

Report 7293/2

November 2024

FOREWORD (Geoenvironmental Investigation Report)

This report has been prepared for the sole internal use and reliance of the McLaren Property Limited. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Calabrian Limited (Calabrian); such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

The report should be read in its entirety, including all associated drawings and appendices. Calabrian cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context.

The findings and opinions conveyed in this report (including review of any third-party reports) are based on information obtained from a variety of sources as detailed within this report, and which Calabrian believes are reliable. All reasonable care and skill has been applied in examining the information obtained. Nevertheless, Calabrian cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

The report represents the findings and opinions of experienced geoenvironmental consultants. Calabrian does not provide legal advice and the advice of lawyers may also be required.

Calabrian cannot be responsible for the consequences of changing practices, revisions to waste management legislation etc that may affect the viability of proposed remediation options.

Calabrian reserve the right to amend their conclusions and recommendations in the light of further information that may become available.

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1 INTRODUCTION

1.1 THE COMMISSION AND BRIEF

Calabrian Limited (Calabrian) has been commissioned by McLaren Property Limited to prepare a Remediation Strategy for land at Upper Brook Street, Manchester, M13 9QD.

Calabrian have already issued the following report:

- Geoenvironmental Appraisal of land at Upper Brook Street, Manchester, M13 9QD. Report No. 7293/1, dated June 2024.

The appointed Remediation Contractor will need to familiarise themselves with the above Reports and comply with all relevant recommendations contained therein.

This document outlines the remediation objectives necessary to protect environmental receptors and render the site suitable for the proposed development. A Method Statement should be prepared, in order to detail how the objectives will be achieved.

The Method Statement should be accompanied by a Designer's Risk Assessment in accordance with the CDM Regulations, 2015. The Method Statement and Risk Assessment should be submitted to, and approved by, the Engineer.

1.2 THE PROPOSED DEVELOPMENT

The proposed redevelopment of the site with comprise two blocks of student accommodation of twenty-two and eleven storeys with a single storey podium linking them together. A proposed site layout has been provided by McLaren and is copied as Drawing 7293/2.

Lower load structures could be founded at shallow depth within the cohesive or granular glacial deposits. Higher loads will be required to found on or in the Chester Formation sandstone at depth either on deep pad or short piled foundations.

2 BACKGROUND

2.1 SITE DESCRIPTION

Details of the site are given below:

- Location: 1.5km south-east of Manchester City Centre
- National Grid Reference: SJ 848 969
- Nearest Postcode: M13 9QD
- Area: 0.45 hectares.

A location plan is shown on Drawing Nos 7293/1.

2.2 GROUND INVESTIGATION

Made Ground

A veneer of asphalt was found across all of the external site areas with concrete of around 200mm inside the building; this was typically underlain by a sandstone sub-base of approximately 300mm thickness. The made ground comprised a variable mixture of cohesive and granular soils with gravel and cobble sized anthropogenic fragments .

Natural Ground

Natural ground comprised medium dense sand becoming sand and sandstone gravel to approximately 3m depth where sandstone was encountered. Thin horizons of sandy clay were found immediately beneath the made ground at some locations.

Groundwater

Based on the results of the investigation it is unlikely that major groundwater flows will be encountered in shallow excavations.

Hazardous Gas

There are no known or suspected areas of landfilling within 250m, and the site is not in area considered susceptible to mines gas, nor is it underlain by shallow mineworkings.

The site is in an area where less than 1% of homes are estimated to be above the radon action level and protective measures are not required.

Given the limited gas generation source (on site made ground) and monitoring results to date the site is likely to be classified as Characteristic Situation 2 (CS2) where gas protection measures are required.

Contamination

Three samples yielded concentrations of lead above its Tier 1 criteria, two additional samples yielded elevated benzo(a)pyrene. Where residual made ground remains beneath landscaped areas (i.e. not beneath buildings or hardstanding) a 600mm thick surface cover of “clean” soil is recommended.

3 RISK ASSESSMENT & TARGET CONCENTRATIONS

Clean-up criteria relevant to the limited contamination encountered at this site are not driven by risks to controlled waters, therefore in the absence of a site-specific Quantitative Risk Assessment, it is conservatively proposed that Calabrian’ generic soil screening values for a CSM that assumes residential apartments with landscaping (public open space) end-use (Calabrian Scenario C).

Information on the derivation and use of these screening values is presented in Appendix B.

4 REMEDIATION STRATEGY (GENERAL)

4.1 AIMS

Remediation aims are to:

- Resolve contamination issues in order to protect environmental receptors and render the site suitable for the proposed development;
- provide a stable development platform (to agreed levels and gradients) for subsequent construction of the proposed development and associated infrastructure; and,
- satisfy requirements of the Local Planning Authority.

4.2 OVERVIEW

The following remediation works are required:

- General site clearance of surface materials and vegetation;
- demolition of buildings;
- break-up of slabs and hardstand;
- crushing of all suitable artificial hard material (ie. concrete/brick etc);
- installation of hazardous gas protection measures; and,
- provision of a minimum 600mm thick cover layer of 'clean' soils in all garden and landscaped areas.

4.3 SITE SET-UP, ORGANISATION AND SAFETY

During the remediation works, all personnel on site will comply with guidance provided in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land".

If at any time during the works personnel begin to feel unwell, they are to inform the Engineer, who will determine appropriate action.

Access into excavations etc. must be controlled and only undertaken in accordance with the Confined Spaces Regulations 1997. The atmosphere in shored trenches in excess of 1.2m should be monitored for oxygen and hazardous gas (methane & carbon dioxide), prior to personnel entering such excavations. Monitoring should continue whilst personnel are working in deep excavations.

4.4 Contractor's Responsibilities

Prior to the commencement of any works the Contractor, in agreement with the Engineer, should:

- Comply with any requirements of McLaren's contract documentation;
- establish the boundaries of the site and the working areas;
- undertake a dilapidation survey of site boundaries, adjacent properties, and highways, via dated photographs or video footage;
- complete a full services search and liaise with all relevant utility companies regarding work in close proximity to their apparatus;
- obtain a pre-demolition (formerly Type 3) asbestos survey report for all buildings to be demolished;
- prepare a detailed Method Statement outlining how the objectives of this Remediation Strategy will be achieved (and obtain approvals); and,
- prepare the necessary COSHH statements and Health & Safety Plan in accordance with CDM regulations.

The Contractor should satisfy the Health & Safety Executive with regard to all matters concerning the health, safety, and welfare of persons on the site.

The Contractor should ensure that:

- Personnel, plant, materials, and other equipment related to the contract are confined within the boundaries of the site;
- any live services lying within the site boundary are marked and protected, or appropriate arrangements made to truncate them;
- good practices relating to personal hygiene are adopted;
- Suitable precautions are implemented at all times to prevent off-site migration of pollutants via airborne dust and vapours;
- suitable precautions are taken to prevent the spread of mud and debris on public highways;
- refuelling of mobile plant is undertaken in a designated area. Above ground oil storage tanks should comply with the requirements of Pollution Prevention Guideline PPG2. A spill kit should be kept on site, adjacent to the designated refuelling area.

4.5 Engineering Supervision and Verification

On satisfactory completion of all the works the Engineer will prepare a Verification Report, in accordance with Stage3 of the UK Governments 'Land contamination risk management'. Copies of the Verification Report will be issued to the Client and the Local Authority.

The Verification Report will stand as certification that the remediation has been carried out in accordance with this Remediation Strategy.

5 REMEDIATION STRATEGY (SPECIFIC OBJECTIVES)

5.1 CONTINGENCY FOR UNKNOWNS

Even after an appropriate preliminary investigation and ground investigation, with exploratory holes on a closely spaced grid (say trial pits at 30m centres), a geoenvironmental appraisal is typically based on inspection of the ground underlying less than 0.5% of the total site area (and much less at depths in excess of about 3.5m). Consequently, there is always a possibility that unanticipated ground conditions will be encountered during the remediation works.

If unanticipated ground is encountered during the remediation works, the Contractor should immediately seek further advice from the Engineer.

Where appropriate any unanticipated grossly contaminated soil/fill should be placed in temporary stockpiles on hardstand or Visqueen, suitably covered and bunded.

Analysis of at least six samples, for an appropriate range of determinands should be undertaken. On receipt of the results, the Engineer will liaise with the Contractor regarding the most appropriate remediation option.

5.2 SITE CLEARANCE

Any trees currently under a Tree Preservation Order (TPO) should be identified and agreed with relevant authorities prior to the commencement of the works. All trees subject to a TPO should be clearly identified and protected by fencing in accordance with BS5837: 2012.

The site should then be cleared of all residual debris, any vegetation, shrubs, bushes, and unprotected trees as instructed by McLaren.

5.3 ASBESTOS

Current legislation (as outlined in HSG 264) requires a pre-demolition (formerly Type 3) asbestos survey to be undertaken, immediately prior to demolition of any building. The Contractor should request a copy of the survey report from McLaren or the Engineer. If no survey report is available, the Contractor will instruct an asbestos survey.

The licensed contractor should submit a Method Statement detailing how the works will be carried out in accordance with the Control of Asbestos Regulations 2012.

Asbestos was identified in four samples of made ground. Supplementary analysis (asbestos quantification) yielded only two results above the limit of measurement (<0.001%), with a maximum percentage of 0.041% per mass.

Provided soils are kept damp the risk of airborne fibre release, even during disturbance associated with excavation, should be negligible, and certainly below the control limit (as set by the Control of Asbestos Regulations 2012) of 0.1 f/cm^3 airborne fibres averaged over a 4-hour period.

If localised fragments of asbestos cement sheeting are encountered during the site remediation and preparatory works. All suspected asbestos-containing material should be recovered by hand and placed in double sealed bags, within a sealed skip for off-site disposal at a suitably licensed landfill site. Personnel involved in this activity should be equipped with appropriate personal protective equipment, including dust masks (minimum FFP3).

5.4 Demolition

Demolition works will commence on completion of any asbestos removal and a "soft-strip" of the existing buildings.

Existing buildings will be demolished in a safe and controlled manner.

All demolition operations should conform to BS 6187:2000 Code of Practice for Demolition. All personnel working on these operations should be fully qualified to do so.

A detailed Method Statement specific to the project must be prepared by the Contractor and submitted to McLaren. The Method Statement should also be submitted to, and approved by, the Engineer and the Local Authority.

Once buildings have been demolished, all surface hardstand and floor slabs should be grubbed-up and stored in a location on site, to be agreed with the Engineer, prior to crushing. Any unsuitable materials should be removed to a suitably licensed landfill site.

5.5 Excavation of Contaminated Soil/Fill

Due to its combustibility near-surface Ash & Clinker might be removed from site or placed beneath buildings or areas of hardstand.

Redistribution will satisfactorily isolate the Ash & Clinker from both end users and potential heat sources.

5.6 Control of Water

Groundwater should be controlled in accordance with CIRIA report 113 “Control of Groundwater for Temporary Works”.

Arrangements should be made to prevent ponding in any excavation “hollows”; the Contractor should ensure that ground levels are of sufficient gradient to enable the collection of surface water run-off in sumps or grips.

Pumping from over-excavated sumps may be required to maintain satisfactory working conditions.

A Silt Management Plan should be prepared by the Contractor, describing the mitigation measures that will be put in place to intercept direct run-off from any disturbed areas, stockpiles etc, thereby preventing any potential impact of adjacent land and nearby watercourses. Surface water run-off will probably require treatment (as a minimum to allow settlement of fines) prior to consented discharge.

Any potentially contaminated water should not be allowed to escape to other areas until the results of the analysis are available and, if required, a suitable means of water treatment has been agreed.

Water collected in sumps should be passed through a series of oil/water separators to remove any oily contamination. Oils trapped in the absorbent medium should be disposed of to a suitably licensed landfill site.

Treated water should then be tankered off-site, or be discharged to sewer, subject to analytical results and local water treatment company consent.

5.7 Removal of Below Ground Obstructions

All foundations associated with existing buildings and other relict structures will be chased out and grubbed-up, in order to remove potential obstructions to new foundations and infrastructure.

Where relict structures are found to retain fluid contaminants, they should be drained first. The drained fluids should be stored in appropriate, sealed tanks/containers and analysed for a range of determinands to be agreed with the Engineer. Fluids may then be tankered off-site, or be discharged to sewer, subject to analytical results and local water treatment company consent.

Deep excavations for the removal of structures etc will be unstable in the short term and continuous side support will be necessary.

Where significantly deep foundations (eg. piles) cannot be removed by conventional means, they are to be cut at a depth to be agreed with the Engineer and the position of the remaining lower section is to be accurately recorded by survey.

Suitable materials derived from grubbing-up should be stored in a location on site, to be agreed with the Engineer, prior to crushing. Any unsuitable materials should be removed to a suitably licensed landfill site.

5.8 Crushing

Production of a selected granular fill should be possible if suitable materials (generated by demolition operations and grubbing-up of floor slabs, foundations, and other relict structures) are crushed.

The crushed product should be screened to remove any unsuitable elements and stockpiled for re-use during the subsequent construction works. Generation of a Class 6 material as defined in the Highways Agency Specification (Series 600) should be possible.

6F2 graded material can contain up to 50% recycled tarmac/asphalt (provided it does not pose a contamination risk to controlled waters). Recycled tarmac can be crushed to yield a 6F3 selected granular material, provided the recovered bitumen content is less than 10% (determined in accordance with BS598-102).

5.9 Backfill of Excavations

Excavations (to remove relict structures, etc) should be backfilled as necessary to achieve the desired levels, with suitable materials and compacted.

5.10 Boundary Issues

McLaren's Designer should ensure that proposed levels tie in with the surrounding infrastructure, and ground levels of adjacent properties (after allowance for the placement of any required soil cover).

Advice should be sought from the Engineer if mobile contamination is encountered close to the site's boundaries.

5.11 Surveying

The Contractor should arrange for the following survey work as directed by the Engineer:

- All setting out necessary to allow the works to proceed;
- recording of the depth and lateral extent of excavations to remove obstructions, contaminated soils etc;
- recording of the positions of any relict obstructions (ie. piles) left in-situ;
- recording of natural ground levels, where natural ground encountered during the earthworks;
- recording the locations and volumes of all stockpiles of suitable materials left on site for McLaren's use during the development works; and,
- as-built survey of the finished surface on completion of the remediation contract

The Contractor should supply the results of this survey work to the Engineer for inclusion in the Verification Report.

5.12 Export to Landfill

Excavation arisings that are unsuitable for retention and re-use on site should be placed in temporary stockpiles on hardstand or polythene sheeting and be suitably covered to minimise the potential for dust/odour nuisance and prevent surface water run-off.

Any material exported from site to landfill should be hauled by a registered waste carrier in accordance with the requirements of the Duty of Care Regulations, 1991 and the Landfill (England & Wales) Regulations 2002.

A transfer note should be completed, signed, and retained by the parties involved. The transfer note should include the volume of waste, the nature of the material and a statement of its chemical composition, details of the source and destination sites, and details of the haulier.

In order to protect the general public from dust and vapour emissions, wagons that are to be used for the haulage of the contaminated material from the site must be sheeted. In addition, the Contractor must ensure that no fluids seep from the wagons.

In order to provide the landfill facility with information regarding chemical composition of the waste, further analysis of any material that requires removal from site may be required.

In addition to the above, Waste Acceptance Criteria testing will be required if the material is classified as inert or hazardous waste.

6 PLACEMENT OF SOIL COVER

Clean inert soil will be placed over any residual made ground in proposed landscaped areas (but not beneath hardstanding). This cover layer is to comprise 600mm of “clean” subsoil and topsoil.

Any material imported for use as cover should be validated in accordance with Calabrian’s Protocol for Soil Importation, copied in Appendix A. This Protocol includes chemical assessment criteria which should not be exceeded.

6.1 VERIFICATION

Isolation of made ground in landscaped areas beneath a cover of “clean” subsoil, and topsoil is often recommended as a remediation solution; most notably when the made ground contains inorganic (and non-volatile organic) contaminants at concentrations above guidance threshold values. A cover solution is not appropriate for volatile or semi-volatile organic contaminants (fuels, solvents etc); removal or treatment will usually be required.

The thickness of cover is dependent on the nature and degree of contamination (and sometimes the Local Authority whose area the site lies within), but typically between 600mm and 1,000mm is required. However, if the made ground is essentially "clean", but contains materials generally considered undesirable as a near-surface material in garden areas (colliery spoil, construction\demolition rubble etc) then a 300mm thick cover should be adequate. If the made ground is essentially "clean" and comprises reworked natural soil, the only cover likely to be required is topsoil.

The “clean” soil cover blocks potential linkages between the contaminated made ground and future residents. Soil cover is not required beneath hardstand or structures.

Soil cover is usually placed many weeks after completion of the preparatory\remediation works, and issue of the associated Verification Report, typically at a relatively late stage in the construction programme.

Prior to placement of soil cover, the appointed remediation contractor and\or groundworker should ensure that ground levels are low enough to accommodate the required cover thickness, taking account of any boundary issues, and without compromising any damp proof course/membranes.

Ideally soil quality should initially be determined by sampling of the source at least seven working days before importation to the development site; this may be achieved by supplier sampling and analysis.

Clearly, if soil cover is imported and placed before confirmation of its suitability, Calabrian cannot guarantee that our validation work will yield the desired results. In which case, it may be necessary to excavate and export the placed soil cover and\or import further "clean" soil.

Where samples have been tested at source, and on receipt of laboratory results, Calabrian will issue confirmation of soil suitability to the Client, who in turn will instruct his Contractor to commence importation. It will probably be necessary to stockpile soil cover materials prior to placement in garden\landscaped areas. Calabrian should inspect the stockpiled material prior to placement, to confirm that it is the same material as previously tested, and

it has not been cross-contaminated with miscellaneous arisings generated during the construction works.

Soil thickness and final quality can only be checked after placement; this should be done before turfing, fencing etc, but ideally after scaffolding has been dismantled.

6.2 Sampling Frequency (to check Soil Quality)

The number of samples taken will be dependent on the nature of the source, and the quantity of material to be imported as detailed below:

- Virgin Quarried Material sampling needs to be 1 or 2 samples depending on the type of stone utilised, to confirm the inert nature of the material.
- Crushed Hardcore, Stone, Brick (excluding asphalt) a minimum of 1 sample per 500m^3 .
- Greenfield/ Manufactured Soils a minimum of 3 samples or, dependent on source and receptor, between 1 per 50m^3 and 1 per 250m^3 .
- Brownfield/ Screened Soils a minimum of 6 samples or dependent on source and receptor, between 1 per 50m^3 and 1 per 100m^3 .

It should be noted that the thickness of placed topsoil is only 100mm to 150mm (compared with subsoil thicknesses of around 500mm). Consequently, where samples are collected after placement (although testing at source is always preferable) testing one topsoil sample per 50m^3. This is not unreasonable anyway, since from a potential contaminant perspective, topsoil, being present at surface, is more important than underlying subsoil.

Occasionally a developer just places 600mm of topsoil (i.e. no subsoil is used). In such circumstances, assuming the topsoil is from a single source, Calabrian would test a minimum of six samples.

A less frequent sampling rate may be appropriate for soils from a greenfield source or where large volumes (say > 5,000m^3) of soil are imported from a single, relatively homogenous source.

6.3 Inspection Frequency (to check Soil Thickness)

The number of inspection pits to check cover thickness and collect samples, should be one pit per 50m^2 plan area and at least one pit per landscaped area if the landscaping is in multiple parcels; a plan of proposed inspection pits may be provided within a site-specific Remediation Strategy where necessary.

6.4 Soil Material Suitability

Inspection pits should be excavated through the entire thickness of any proposed in-situ source material, or cover material (if inspection is post-placement). Stockpiles should be assessed from both the surface and by digging into the “core”, to ensure the material is reasonably homogenous.

The soil material should:

- Be clean and free of foreign debris, building waste materials, glass sharps, or contaminants;
- topsoil should not have a gravel content of greater than 30% by dry weight and should generally have a maximum stone size of 50mm in any one direction;
- subsoil should generally have a maximum stone size of 150mm in any one direction; and,
- not have been sourced from an area within 7m laterally, or 3m vertically, of Japanese Knotweed plants, and not contain any Japanese Knotweed fragments (rhizomes, leaves, stems etc).

6.5 Laboratory Analysis

Whether samples are taken at source, from stockpiles on site, or from landscaped after placement, they should be forwarded to an analytical laboratory for testing in accordance with one of the Schedules detailed in Table 1.

Imported topsoil should be subject to such testing, wherever it is *not* being sourced from a reputable supplier; soil transfer stations would not usually be classed as a reputable supplier. In addition, some analysis in accordance with BS3882 may occasionally be appropriate.

Table 1 – Test schedule

Source	Definition	Test Schedule	Other requirements\Remarks
Greenfield	No 'source' of contamination present i.e. undeveloped; absence of made ground.	*pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron.* *TOC & Speciated PAH.* *Asbestos ID*	
"Low-risk" Brownfield	Development site (on former greenfield land) with excess soils, or a "low-risk" brownfield site (eg former school, offices, housing estate etc).	*pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron.* *TOC, BTEX, speciated TPH & Speciated PAH.* *Asbestos ID*	
Soil Transfer Stations & Other Brownfield	Source is a soil transfer stations. Potential source anticipated i.e. current or historical industrial or commercial use; evidence of bonfires; presence of made ground.	*pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron.* *TOC, Speciated PAH BTEX, and speciated TPH.* *Asbestos ID*	

***NB** The schedules detailed above have been prepared in accordance with the Secondary Model Procedures. This document states that analysis should be relevant to potential sources and not merely a set list of parameters applied to each site.*

Additional determinands could be scheduled, although if considered necessary, would probably suggest the material is unlikely to be suitable for use as clean cover in gardens.

Chemical assessment (Tier 1) criteria for imported soils are provided in Table 2.

Table 2 - Chemical Assessment Criteria for Imported Soils

Contaminant	Residential End Use Without Home Grown Produce (mg/Kg) in Soil (1% SOM)	Comments/Notes
Inorganic Arsenic	40	
Cadmium	85	
Chromium (III)	910	
Chromium (VI)	6	
Copper	100 (pH<6), 135 (pH6-7), 200 (pH>7)	
Lead	310	
Inorganic Mercury	56	
Nickel	60 (pH<6), 75 (pH6-7), 110 (pH>7)	
Selenium	430	
Zinc	200 (300 if pH >7.0)	
Total PAH	50	
Speciated PAH		
Acenaphthene	3,000	
Acenaphthylene	2900	
Anthracene	31,000	
Benzo(a)anthracene	11	
Benzo(a)pyrene	3.2	
Benzo(b)fluoranthene	3.9	
Benzo(k)fluoranthene	110	
Benzo(g,h,i)perylene	360	
Chrysene	30	
Dibenzo(a,h)anthracene	0.31	
Fluoranthene	1,500	
Fluorene	2,800	
Indeno(1,2,3-cd)pyrene	46	
Naphthalene	2.3	
Phenanthrene	1,300	
Pyrene	3,700	
TPH Speciated		
Aliphatic C5-C6	42	
Aliphatic C6-C8	100	
Aliphatic C8-C10	27	
Aliphatic C10-C12	130	
Aliphatic C12-C16	1,100	
Aliphatic C16-C21	65,000	
Aliphatic C21-C35	65,000	
Aromatic C5-C7	370	
Aromatic C7-C8	860	
Aromatic C8-C10	47	
Aromatic C10-C12	250	
Aromatic C12-C16	1,800	

Contaminant	Residential End Use Without Home Grown Produce (mg/Kg) in Soil (1% SOM)	Comments/Notes
Aromatic C16-C21	1,900	
Aromatic C21-C35	1,900	
Others		
Asbestos	Should not be detected	
Water soluble sulphate	0.5g/l	
Acidity (pH)	Not less than 5	

It should be noted that many of the compounds detected by laboratory analysis for TPH and PAH are naturally occurring in coal, humic acid, bark, leaf litter etc; these are clearly not 'sources' within the legal definition. Calabrian can undertake further risk assessment where PAH screening values are exceeded, *but* inspection of the soils has not identified any petroleum or combustion derived material.

6.6 Verification Report

The purpose of verification documentation is to provide transparent reasoning why the remediation was required, a methodology about how it was to be undertaken and proof that the specified works have been undertaken and to provide confirmation that the site is "suitable for its intended use".

The report will include supporting documentation such as laboratory analysis results, delivery tickets for material, certificates for imported material (or if unavailable, documented evidence of the source of the Greenfield material), trial pit logs etc.

The report should include details of any measures required to maintain the cover system integrity in the future e.g. successive construction phases (management plans) and longer term (restrictive covenants on title deeds).

Photographs will also be included to evidence soil cover placement and quality, these will include (where appropriate):

- Photographs of any stockpiles and quarantine areas;
- depth of soi cover installed including survey staff as a scale;
- quality of the material to be used as cover eg absence of large stones;
- location of geotextile separator and visual warning membranes;
- method of placement and different layers if appropriate;
- inclusion of background features which will aid locating the photograph; and,
- inclusion of site identification boards within the photos which show the date, position taken i.e. corner of plot 3 and the site name.

The presence of good quality photographs is essential to prove beyond doubt that the remediation has been undertaken as specified both by method and position, and that the images have been taken from the specific area stated.

7 HAZARDOUS GAS PROTECTION

Based on the site characterisation discussed above, the proposed foundation solution, and with reference to the gas protection "scoring" system outlined in BS 8485:2015 + A1:2019 for Building Type B[1], Calabrian consider that the following protective measures should be incorporated in all new structures:

Characteristic Situation (Wilson & Card, 1999)	Gas "score" req'd by BS 8485	Protective Measures		
		Floor Slab (BS8485 "score")	Sub-floor ventilation (BS8485 "score")	Membrane Type (BS8485 "score")
2	3.5 (Type B)	'Beam and Block' segmental suspended subfloor – **(0)**. Reinforced ground bearing slab – **(0.5)**. Reinforced, cast in-situ suspended slab (well reinforced with minimal service penetrations & water bars around all slab penetrations & at joints) – **(1.5)**. Basement floor and walls conforming to BS8102:2009, Grade 2 waterproofing – **(2.0)**. Basement floor and walls conforming to BS8102:2009, Grade 3 waterproofing – **(2.5)**.	Layer of low permeability and/or is not terminated in a venting trench (or similar). **(0)** Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building) - **(0.5)**. For smaller commercial units, passive sub-floor ventilation; venting layer could be: i. A min. 200mm clear void **(2.5)**, or ii. A proprietary void former (expanded polystyrene shuttering) providing an equivalent clear void depth of 60mm **(2.5)**, or iii. Min. 300mm thick blanket of 20mm single size gravel, not MOT Type 1 **(0.5)**. Min. ventilation = 2,500 mm²/m run of external wall (via air bricks on each of 2 opposite sides), with 100mm pipes at 2m centres or honeycombing of any sub-floor sleeper walls.	Gas resistant membrane meeting criteria of Table 7 BS8485:2019 with verification in accordance with CIRIA C735 [N1]. **(2.0)** ***Vented CS2 this will comprise independent visual inspection. ***Unvented this will comprise independent visual inspection and air lance integrity testing.

7.1 MEMBRANE INSTALLATION

Installers

[1] ***Type B building***: *private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.*

Installation of gas protection measures must be executed to National Occupational Standards (VR612 and VR613) and installers should ideally hold a level 2 NVQ diploma in Sub-structure Work Occupations (Construction) – Installation of Gas Membranes.

Installation Process

The Installer will provide a detailed Method Statement to the Verifier detailing the membrane installation process and approximate programme of works. This should include reference to the details of the extent of overlap and method of sealing (these must be in line with manufacturer's instructions).

Membrane Damage Protection

Prior to installation of the floor construction (placement of insulation, concrete slab etc) is it essential that the integrity of the installed is not compromised.

For the ventilation system this would include blocking of the system by debris, detachment of telescopic vents or vent pipes and contamination of vent clean materials with fine particles.

The membrane is particularly susceptible to damage from the following (not an exhaustive list):

- Degradation of membrane due to prolonged exposure to UV light;
- damage to a gas membrane from a mesh reinforcement tie wire;
- prevent trafficking of the membrane by vehicle, plant and where possible the labour force;
- debris above or below membrane causing damage (consider use of sand blinding layer below and careful cleaning above and below). This could include debris created by follow-on trades, installation of scaffolding etc;
- damage where membrane becomes stressed (consider use of bitumen reinforced strips on corners or other critical junctions).

The use of protective boards/geotextile or insulation between the membrane and reinforcement should be considered immediately post placement and inspection to prevent damage. Particular attention should also be given to pipe penetrations, as often when insulation is laid, large gaps are left due to the time it takes to cut around pipes, which may expose the gas membrane to damage.

Such measures should be communicated to all site personnel during the site induction and should be stated in the gas membrane installer's method statement.

7.2 VERIFICATION

Verifier

Formal qualifications/experience/training of the person carrying out the verification. Full details of what the verification process will comprise and at what stage verification will be carried out.

Visual Inspection – Venting System

Venting measures, both passive and active controls, should be subject to a visual verification inspection to establish that installation is adequate and complies with the design and the

specification. If a granular layer is used, the material should be tested to ensure the grading will enable it to function as a venting layer.

The inspection should cover floor areas, paying particular attention to walls and any other locations where venting systems might be positioned. Any discrepancies with the design drawings should be highlighted. These may include missing air vents and air bricks, inadequate grading of gravel vent layers, and incorrect types of geocomposite or polystyrene vent layers. The size of connecting pipes, venting through sleeper walls, and voids and void formers should also be checked. Particular attention should be paid to venting through sleeper walls, the location of vents in relation to final ground levels and the potential for debris to block air bricks.

Visual Inspection – Gas Membrane

The gas membrane installation should be subject to a visual verification inspection to establish the adequacy of the ground preparation and subsequently possible damage to the installed gas membrane.

inspections should cover both the ground prepared for the gas membrane and the gas membrane itself over the whole floor area, paying particular attention to laps, edges and the sealing of service entries and penetrations such as vent pipes and pile caps.

Any discrepancies with the membrane installation method recommended by the gas membrane supplier should be highlighted. These may include small or large holes and rips, tears and punctures, absence of tape (double sided or single sided tape) on the lapped areas, loose or unstuck tape, inadequate corner details, and unbounded seams such as loose edges and 'fish mouths' in the gas membrane. Tapes used to join gas membranes should be inspected to make sure they are compatible with the gas membrane being joined and are as specified by the gas membrane supplier or specifier. If a gas membrane has a third-party accreditation, eg BBA certificate, the installation requirements should be checked against it, including the need for protection boards or similar. Where welded joints are used, the verifier should ensure they are correctly tested.

Air Lance Testing - Joints

Air lance testing identifies unbonded areas of seam by directing a high-pressure jet of air at the seam. The air is at a minimum pressure of 345kPa (3.45 Bar) via a 4.8 mm nozzle and it is located no more than 50 mm from the seam being tested.

Seams will be checked to ensure a good seal.

Non-Conformance and Defect Rectification

Any discrepancies from the ventilation system design as highlighted by the points in Section 6.2 above should be corrected and confirmed by visual inspection before further construction continues.

Repairs to the membrane as required by the points in Section 6.3 above should be instructed and observed on the same day as the site visit or inspected at a later date.

Verification, Checklist and Watchpoints

Verification should be undertaken in accordance with CIRIA C375 using the 'Visual Inspection Checklist' provided in Appendix C.

Photographs showing the ventilation system (clear void, sleeper walls, vent pipe etc) and installed membrane including examples of specific key installations such as lapped areas,

DPC connections, corner details and service/stanchion/column penetrations will be included in the Verification Report.

Verification Report

On completion of gas protection measures installation a Gas Protection Measures Verification Report will be issued confirming that the gas protection measures were installed as agreed and that the membrane was free from tears and punctures and was lapped and sealed as agreed at joins and around services and sub floor voids were clear and free from debris.

The verification report will include copies of the signed 'Visual Inspection of Gas Protection Measures' check list(s).

DRAWINGS	
7293/1	Site Location Plan
7293/2	Proposed Site Layout
7293/7	Geoenvironmental Summary

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client	MCLAREN PROPERTY LIMITED
project	UPPER BROOK STREET, MANCHESTER, M13 9QD
drawing title	SITE LOCATION
drawing number	7293/1
revision	–
drawing status	Final
scale	1:25,000 @ A4
date	18/04/2024
drawn by	RJH
checked by	–

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notes

Proposed layout reproduced from Reform Landscape Architecture drawing referenced 0967-RFM-XX-00-DR-L-0001, Rev P02.

N
W E
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rev. description

MCLAREN PROPERTY LIMITED

client

UPPER BROOK STREET,
MANCHESTER, M13 9QD

project

PROPOSED LAYOUT

drawing title

drawing number 7293/2

revision –

drawing status Final

scale 1:400 @A3

date 18/04/2024

drawn by RJH

checked by –

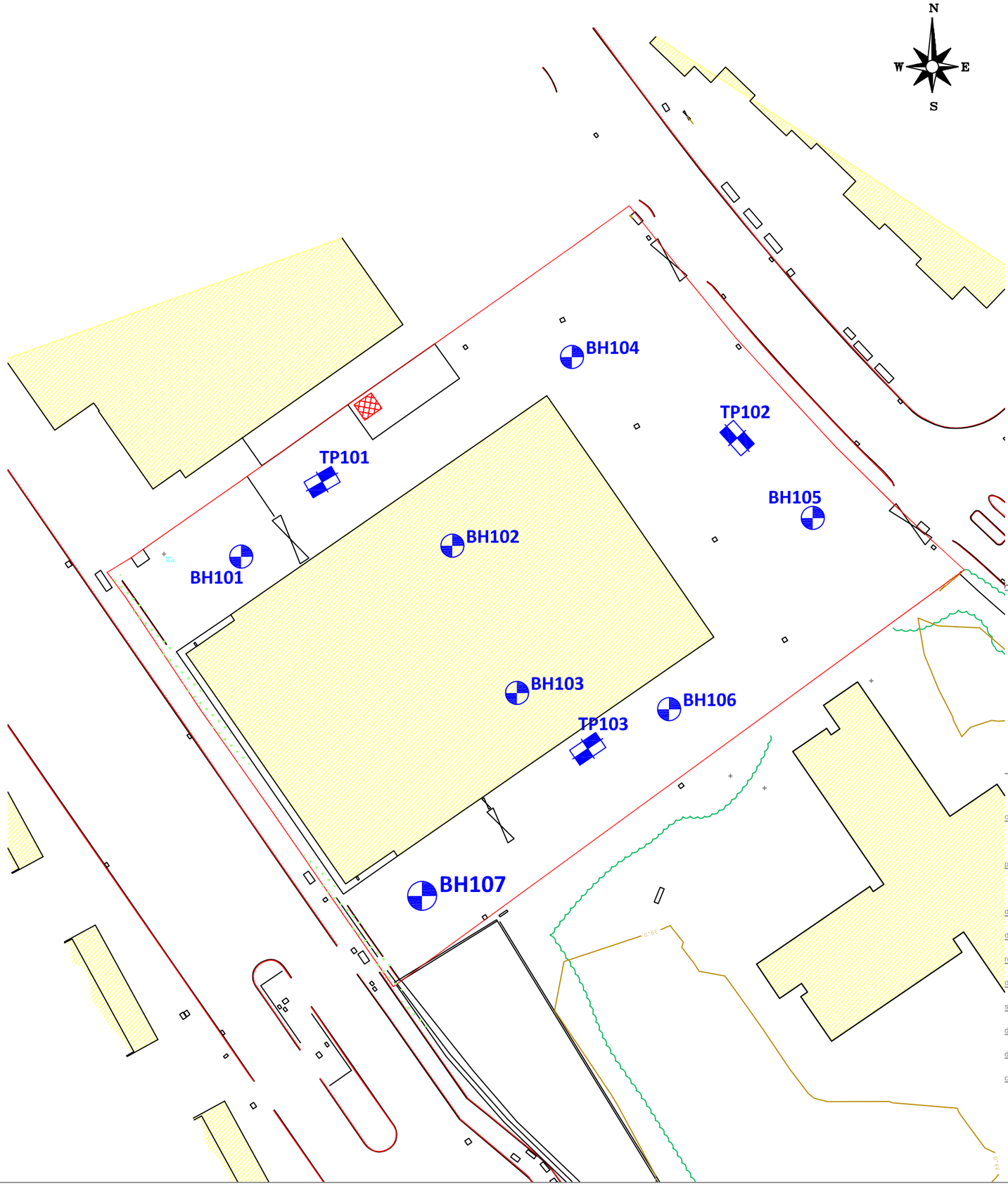
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GEOENVIRONMENTAL SUMMARY

Site Description	The site comprises a former car dealership and servicing centre. A single storey building lies in the central area of the site. External areas are all tarmac surfaced. In the north lies a small lean-too building formerly used for car cleaning and valeting. To the west of this is a small structure that houses waste materials and what appears to be a small above ground waste oil tank.
History	The site was developed with likely residential properties from at least the mid 19th Century until the mid 20th Century when a 'works' building occupied the site. The exiting building was likely constructed in the late 1980's.
Made Ground	Made ground was found across the site and was typically around 1.0m in thickness. A veneer of asphalt was found across all of the external site areas with concrete of around 200mm inside the building; this was typically underlain by a sandstone sub-base of approximately 300mm thickness. The made ground comprises a mixture of cohesive and granular soils with occasional thin horizons of ashy soil.
Natural Ground	Typically comprised medium dense sand becoming sand and sandstone gravel to approximately 3m depth where sandstone was encountered. Thin horizons of sandy clay were found immediately beneath the made ground at some locations.
Contamination & Remediation	Three samples yielded concentrations of lead above its Tier 1 criteria, two additional samples yielded elevated benzo(a)pyrene. Where residual made ground remains beneath landscaped areas (i.e. not beneath buildings or hardstanding) a 600mm thick surface cover of "clean" soil is recommended.
Hazardous Gas	There are no significant sources of hazardous gas generation within influencing distance of the site; however, on-site made ground does present a very low risk. initial gas monitoring has not yielded any elevated concentrations or flows of hazardous gas.
Mining & Quarrying	The site is located within a Coal Mining Reporting Area; however, there are no shallow coal seams beneath the site that could effect its stability. There are no quarries within 250m.
Foundations	Made ground is not generally considered a suitable founding material and foundations should be taken through it, into underlying natural in-situ strata of adequate bearing capacity. Weathered Chester Formation sandstone should provide sufficient bearing capacity to enable the adoption of deep spread foundations or short piles dependent upon proposed loads.
Groundwater & Excavations	To date monitoring has not identified any shallow groundwater although the use of water as a rotary drilling flush medium will have masked groundwater. The stability of excavations within both made and natural ground was generally good.
Flooding & Drainage	The EA indicate that the site is located within an indicative floodplain and is at risk from surface water flooding. Infiltration testing suggests that soakaways may provide a suitable means of surface water disposal.

Significant developer abnormals relating to geoenvironmental issues at the site are:
- Soil cover in any landscaped areas.
- Short piles.

This brief summary should not be assumed to represent a complete account of all the potential geoenvironmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.



notes

Proposed layout reproduced from Reform Landscape Architecture drawing referenced 0967-RFM-XX-00-DR-L-0001, Rev P02.

CALABRIAN 2024 INVESTIGATION

TRIAL PIT LOCATION

BOREHOLE LOCATION

APPROXIMATE SITE BOUNDARY

rev. description

client	MCLAREN PROPERTY LIMITED
project	UPPER BROOK STREET, MANCHESTER, M13 9QD
drawing title	GEOENVIRONMENTAL SUMMARY
drawing number	7293/7
revision	–
drawing status	Final
scale	1:500 @A3
date	24/06/2024
drawn by	RJH
checked by	–

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APPENDIX A PROTOCOL FOR IMPORTATION & USE OF SOIL COVER

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IMPORTATION & USE OF SOIL COVER

Introduction.

Isolation of made ground in landscaped areas beneath a cover of "clean" subsoil, and topsoil is often recommended as a remediation solution; most notably when the made ground contains inorganic (and non-volatile organic) contaminants at concentrations above guidance threshold values. A cover solution is not appropriate for volatile or semi-volatile organic contaminants (fuels, solvents etc); removal or treatment will usually be required.

The thickness of cover is dependant on the nature and degree of contamination (and sometimes the Local Authority whose area the site lies within), but typically between 600mm and 1,000mm is required. However, if the made ground is essentially "clean", but contains materials generally considered undesirable as a near-surface material in garden areas (colliery spoil, construction\demolition rubble etc) then a 300mm thick cover should be adequate. If the made ground is essentially "clean" and comprises reworked natural soil, the only cover likely to be required is topsoil.

The "clean" soil cover blocks potential linkages between the contaminated made ground and future residents. Soil cover is not required beneath hardstand or structures.

Soil cover is usually placed many weeks after completion of the preparatory\remediation works, and issue of the associated Verification Report, typically at a relatively late stage in the construction programme.

Prior to placement of soil cover, the appointed remediation contractor and\or groundworker should ensure that ground levels are low enough to accommodate the required cover thickness, taking account of any boundary issues, and without compromising the DPC.

Ideally soil quality should initially be determined by sampling of the source at least 7 working days before importation to the development site; this may be achieved by supplier sampling and analysis.

Clearly, if soil cover is imported and placed before confirmation of its suitability, Calabrian cannot guarantee that our validation work will yield the desired results. In which case, it may be necessary to excavate and export the placed soil cover and\or import further "clean" soil.

Where samples have been tested at source, and on receipt of laboratory results, Calabrian will issue confirmation of soil suitability to the Client, who in turn will instruct his Contractor to commence importation. It will probably be necessary to stockpile soil cover materials prior to placement in garden\landscaped areas. Calabrian should inspect the stockpiled material prior to placement, to confirm that it is the same material as previously tested, and it has not been cross-contaminated with miscellaneous arisings generated during the construction works.

Soil thickness and final quality can only be checked after placement; this should be done before turfing, fencing etc, but ideally after scaffolding has been dismantled.

Sampling Frequency (to check Soil Quality): The number of samples taken will be dependant on the nature of the source, and the quantity of material to be imported as detailed below:

End-Use	Greenfield Soils	Remediated Soils	Brownfield Soils	Unknown Soil Source
Residential Gardens	1:200m^3	1:100m^3	1:50m^3	1:50m^3
Soft Landscaping	1:200m^3	1:150m^3	1:150m^3	1:150m^3
Other	1:200m^3	1:200m^3	1:200m^3	1:200m^3

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IMPORTATION & USE OF SOIL COVER

It should be noted that the thickness of placed topsoil is only 100mm to 150mm (cf subsoil thicknesses of around 500mm). Consequently, where samples are collected after placement (although testing at source is always preferable) testing one topsoil sample per 50m^3. This is not unreasonable anyway, since from a potential contaminant perspective, topsoil, being present at surface, is more important than underlying subsoil.

Occasionally a developer just places 600mm of topsoil (i.e. no subsoil is used). In such circumstances, assuming the topsoil is from a single source, Calabrian would test a minimum of 6 samples.

A less frequent sampling rate may be appropriate for soils from a greenfield source or where large volumes (say > 5,000m^3) of soil are imported from a single, relatively homogenous source.

Inspection Frequency (to check Soil Thickness): The number of inspection pits to check cover thickness and collect samples, should be 1 pit per 50m^2 plan area and at least 1 pit per landscaped area if the landscaping is in multiple parcels; a plan of proposed inspection pits may be provided within a site specific Remediation Strategy where necessary.

Soil Material Suitability: Inspection pits should be excavated through the entire thickness of any proposed in-situ source material, or cover material (if inspection is post-placement). Stockpiles should be assessed from both the surface and by digging into the "core", to ensure the material is reasonably homogenous.

The soil material should:

- Be clean and free of foreign debris, building waste materials, glass sharps, or contaminants;
- topsoil should not have a gravel content of greater than 30% by dry weight and should generally have a maximum stone size of 50mm in any one direction;
- subsoil should generally have a maximum stone size of 150mm in any one direction; and,
- not have been sourced from an area within 7m laterally, or 3m vertically, of Japanese Knotweed plants, and not contain any Japanese Knotweed fragments (rhizomes, leaves, stems etc).

Laboratory Analysis: Whether samples are taken at source, from stockpiles on site, or from landscaped after placement, they should be forwarded to an analytical laboratory for testing in accordance with one of the Schedules detailed in Table 1.

Imported topsoil should be subject to such testing, wherever it is *not* being sourced from a reputable supplier; soil transfer stations would not usually be classed as a reputable supplier. In addition, some analysis in accordance with BS3882 may occasionally be appropriate.

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Table 1 – Test schedule

Source	Definition	Test Schedule	Other requirements\Remarks
Greenfield	No 'source' of contamination present i.e. undeveloped; absence of made ground.	*pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron.* *TOC & Speciated PAH.* *Asbestos ID*	
"Low-risk" Brownfield	Development site (on former greenfield land) with excess soils, or a "low-risk" brownfield site (eg former school, offices, housing estate etc).	*pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron.* *TOC, BTEX, speciated TPH & Speciated PAH.* *Asbestos ID*	
Soil Transfer Stations & Other Brownfield	Source is a soil transfer stations. Potential source anticipated i.e. current or historical industrial or commercial use; evidence of bonfires; presence of made ground.	*pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron.* *TOC, Speciated PAH BTEX, and speciated TPH.* *Asbestos ID*	

NB The schedules detailed above have been prepared in accordance with the Secondary Model Procedures. This document states that analysis should be relevant to potential sources and not merely a set list of parameters applied to each site.

Additional determinands could be scheduled, although if considered necessary, would probably suggest the material is unlikely to be suitable for use as clean cover in gardens.

Chemical assessment (Tier 1) criteria for imported soils are provided in Table 2.

Table 2 - Chemical Assessment Criteria for Imported Soils

Contaminant	Residential End Use Without Home Grown Produce (mg/Kg) in Soil (1% SOM)	Comments/Notes
Inorganic Arsenic	40	
Cadmium	85	
Chromium (III)	910	
Chromium (VI)	6	
Copper	100 (pH<6), 135 (pH6-7), 200 (pH>7)	
Lead	310	
Inorganic Mercury	56	
Nickel	60 (pH<6), 75 (pH6-7), 110 (pH>7)	
Selenium	430	
Zinc	200 (300 if pH >7.0)	
Total PAH	50	
Speciated PAH		
Acenaphthene	3,000	
Acenaphthylene	2900	
Anthracene	31,000	
Benzo(a)anthracene	11	
Benzo(a)pyrene	3.2	
Benzo(b)fluoranthene	3.9	
Benzo(k)fluoranthene	110	

Contaminant	Residential End Use Without Home Grown Produce (mg/Kg) in Soil (1% SOM)	Comments/Notes
Benzo(g,h,i)perylene	360	
Chrysene	30	
Dibenzo(a,h)anthracene	0.31	
Fluoranthene	1,500	
Fluorene	2,800	
Indeno(1,2,3-cd)pyrene	46	
Naphthalene	2.3	
Phenanthrene	1,300	
Pyrene	3,700	
TPH Speciated		
Aliphatic C5-C6	42	
Aliphatic C6-C8	100	
Aliphatic C8-C10	27	
Aliphatic C10-C12	130	
Aliphatic C12-C16	1,100	
Aliphatic C16-C21	65,000	
Aliphatic C21-C35	65,000	
Aromatic C5-C7	370	
Aromatic C7-C8	860	
Aromatic C8-C10	47	
Aromatic C10-C12	250	
Aromatic C12-C16	1,800	
Aromatic C16-C21	1,900	
Aromatic C21-C35	1,900	
Others		
Asbestos	Should not be detected	
Water soluble sulphate	0.5g/l	
Acidity (pH)	Not less than 5	

It should be noted that many of the compounds detected by laboratory analysis for TPH and PAH are naturally occurring in coal, humic acid, bark, leaf litter etc; these are clearly not 'sources' within the legal definition. Calabrian can undertake further risk assessment where PAH screening values are exceeded, *but* inspection of the soils has not identified any petroleum or combustion derived material.

Verification Reports

The purpose of verification documentation is to provide transparent reasoning why the remediation was required, a methodology about how it was to be undertaken and proof that the specified works have been undertaken and to provide confirmation that the site is "suitable for its intended use".

The report will include supporting documentation such as laboratory analysis results, delivery tickets for material, certificates for imported material (or if unavailable, documented evidence of the source of the Greenfield material), trial pit logs etc.

IMPORTATION & USE OF SOIL COVER

The report should include details of any measures required to maintain the cover system integrity in the future e.g. successive construction phases (management plans) and longer term (restrictive covenants on title deeds).

Photographs will also be included to evidence soil cover placement and quality, these will include (where appropriate):

- Photographs of any stockpiles and quarantine areas;
- depth of soi cover installed including survey staff as a scale;
- quality of the material to be used as cover eg absence of large stones;
- location of geotextile separator and visual warning membranes;
- method of placement and different layers if appropriate;
- inclusion of background features which will aid locating the photograph; and,
- inclusion of site identification boards within the photos which show the date, position taken i.e. corner of plot 3 and the site name.

The presence of good quality photographs is essential to prove beyond doubt that the remediation has been undertaken as specified both by method and position, and that the images have been taken from the specific area stated.

APPENDIX B TIER 1 SCREENING VALUES

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Soil Screening Values used by Calabrian

In March 2002 DEFRA and the Environment Agency published a series of technical papers (R&D Publications CLR 7, 8, 9 and 10) outlining the UK approach to the assessment of risk to human health from land contamination. In 2008 CLR 7, 9 and 10 and all corresponding SGV and Tox reports were withdrawn and superseded by new guidance including:

- Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration- CL:AIRE, 2020
- Evaluation of models for predicting plant uptake of chemicals from soil - Science Report – SC050021/SR
- Human health toxicological assessment of contaminants in soil - Science Report: SC050021/SR2
- Updated technical background to the CLEA model - Science Report: SC050021/SR3
- CLEA Software (Version 1.05) Handbook Science report: SC050021/SR4
- Compilation of data for priority organic pollutants for derivation of Soil Guideline Values - Science Report: SC050021/SR7

The approach set out in these documents represents current scientific knowledge and thinking; and includes the Contaminated Land Exposure Model (CLEAv1.06). The Environment Agency are in the process of using this updated approach to regenerate a selection of Soil Guideline Values (SGVs).

CLEA SGVs were derived for standard land use scenarios predominantly in the context of Part IIA, using a conceptual site model (CSM) defined in SR3. Calabrian have incorporated amendments to the CSM used to derive SGVs that more accurately reflect redevelopment within the planning regime; consequently, Calabrian have not necessarily adopted any published SGV as a screening value.

The CLEA conceptual site model assumes a source located in a sandy loam, with 6% soil organic matter (SOM) - equivalent to 3.5% total organic carbon (TOC). Calabrian consider it reasonable to adopt the CLEA default TOC for made ground. However, where the average TOC value for a particular soil type is significantly lower than the 3.5%, Calabrian adopt refined Screening Values.

In March 2014 DEFRA published Category 4 Screening Levels (C4SLs) for six substances (arsenic, cadmium, chromium IV, lead, benzene & benzo(a)pyrene) for four generic land-uses comprising residential, commercial, allotments and public open space.

The methodology for deriving both the previous Soil Guideline Values and the new Category 4 Screening Levels is based on the Environment Agency's Contaminated Land Exposure Assessment (CLEA) methodology. Development of Category 4 Screening Levels has been achieved by modifying the toxicological and\or exposure parameters used within CLEA (while maintaining current exposure parameters).

The Part 2A Statutory Guidance was developed on the basis that Category 4 Screening Levels could be used under the planning regime. However, policy responsibility for the National Planning Policy Framework falls to the Department for Communities and Local Government. Defra anticipate that, where they exist, C4SLs will be used as generic screening criteria, and Calabrian consider C4SLs to be suitable for use as Tier 1 Screening Values. Calabrian have discussed this matter with both NHBC and YAHPAC (collection of Yorkshire & Humberside local authorities) and received confirmation that they are satisfied with this approach.

In general Calabrian have adopted the use of the LQM/CIEH Suitable 4 Use Levels (S4ULs) as Tier 1 Screening Criteria. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3373. All rights reversed.

Calabrian have adopted Tier 1 Screening Criteria for five different CSMs (Scenarios); these are:

- A - Residential with homegrown produce.
- B - Residential without homegrown produce.
- C – Residential apartments with landscaping/public open space (POS).
- D - Commercial/industrial with landscaping.
- E - Dedicated sports grounds or parkland/ public open space (POS).

The **exposure** pathways considered for each scenario are detailed in the Table below.

Scenario	Land use	Pathways	Justification
A	Residential with homegrown produce, but no cover (or only up to 300mm)	• Direct ingestion of soil • Dermal contact • Consumption of vegetables and soil attached to vegetables • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	Minimal cover – insufficient to break any pathways therefore all exposure pathways are relevant
B	Residential apartments with landscaped areas and minimum 300mm cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. However consumption of home grown produce not included as unlikely to be grown in landscaped areas. Where vegetables are to be grown site specific QRA may be required.
C	Grassed area or play park in close proximity to housing. Assumes minimum 300mm cover (growing medium).	• Direct ingestion of soil • Dermal contact • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. Assumes an area where some children play regularly and others less.
D	Commercial/ industrial with landscaped areas no cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. Assumed the commercial development consists of offices to provide a conservative assessment.
E	Dedicated sports grounds. Assumes minimum 300mm cover (growing medium).	• Direct ingestion of soil • Dermal contact • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. Assumes an where exposure only occurs to players and grounds staff

The Soil Screening Values referred to in this document are **not** intended to be used when considering potential risks associated with:

- Existing land uses in the context of Part IIA of the Environment Protection Act 1990;
- end uses such as allotments, sports fields, children's playgrounds, care homes, hospitals etc; and
- controlled waters.

With respect to **inorganic** determinands, Calabrian derived Tier 1 values for the four Scenarios A to E are presented below:

Inorganic Contaminant	Source	C4SL*	LQM/ CIEH S4UL	Tier 1 Assessment Criteria (mg/kg) for Scenarios A to E					Comments/Notes
				A	B	C	D	E	
As	CLEA	37	37	37	40	79	640	170	LQM/CIEH S4UL adopted.
Cd	CLEA	26	11	11	85	120	190	532	LQM/CIEH S4UL adopted.
Cr	CLEA		910	910	910	1,500	8,600	33,000	LQM/CIEH S4UL adopted. Assumes Cr is CrIII.
Pb	CLEA	200		200	310	630	2,330	1,300	C4SLs adopted.
Ni	CLEA		130	130	180	230	980	3,400	LQM/CIEH S4UL. Assessment of health risk only.
				60 (pH<6), 75 (pH6-7), 110 (pH>7)					*Phytotoxicity.*
Se	CLEA		250	250	430	1,100	12,000	1,800	LQM/CIEH S4UL adopted.
Hg	CLEA		40	40	56	120	11,000	240	LQM/CIEH S4UL. Assumes in an inorganic compound.
B	Drinking		290	290	11,000	21,000	240,000	46,000	LQM/CIEH S4UL adopted.
Cu	EPA		2,400	2,400	7100	12,000	68,000	44,000	LQM/CIEH S4UL adopted. Assessment of health risk only.
				100 (pH<6), 135 (pH6-7), 200 (pH>7)					*Phytotoxicity.*
Zn	DoE		3,700	3,700	40,000	81,000	73,000	170,000	LQM/CIEH S4UL adopted. Assessment of health risk only.
				200 (300 if pH >7.0)					Phytotoxicity.
Cyanide	CLEA			527	530		14,000		SSV

* *For a residential end use*

With respect to **organic** determinands, Calabrian derived Tier 1 values (assuming 6% SOM) for the four Scenarios A to E are presented below:

Organic Contaminant (all sourced via CLEA)	Tier 1 Assessment Criteria (mg/kg) for Scenarios A to E					Comments/Notes
	A	B	C	D	E	
Benzene	0.37	1.4	73	90	110	LQM/CIEH S4UL adopted.
Toluene	660	3900	56,000	180,000^{VAP} (4,360)	100,000^{vap} (4,360)	LQM/CIEH S4UL adopted.
Ethyl Benzene	260	440	25,000	27,000^{VAP} (2,840)	27,000^{VAP} (2,840)	LQM/CIEH S4UL adopted.
Xylenes	310	430	43,000	30,000^{sol} (3,170)	31,000^{sol} (3,170)	LQM/CIEH S4UL adopted (assumes worst-case p-xylene).
Phenol	412	557	557	38,700		
PCBs	1.7	1.8	1.8	1.8		Based on toxicity of EC7.
Benzo(a)pyrene	3.0	3.2	5.7	36	13	LQM/CIEH S4UL adopted.
Naphthalene	13	13	4,900	1,100	3,000	LQM/CIEH S4UL adopted.
Gasoline Range Organics#	42	42	1,000	1,000	1,000	See **3-step** assessment of TPH below.
Diesel Range Organics#	130	130	5,000	5,000	1,000	
Lubricating Range Org#	1,000	1,000	5,000	5,000	1,000	

* *For a residential end use*

LQM/CIEH S4UL adopted, 6% SOM

Note: **PAH** cannot be assessed as a single "total" value, as each individual PAH compound has different toxicity and mobility in the environment. Speciated analysis is required to determine the concentrations of the various compounds, most notably the key PAHs: Benzo(a)Pyrene (considered the most toxic of the PAHs); and Naphthalene (the most mobile and volatile of the PAHs).

Similarly, **TPH** cannot be assessed as a single "total" value, and reference has been made to the Environment Agency's document P5-080/TR3, "*The UK approach for evaluating human health risks from petroleum hydrocarbons in soils*". This document supports the assumptions and recommendations made by the US Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG). The TPHCWG have broken down "TPH" into thirteen representative constituent fractions or "EC Bandings". The TPHCWG have derived a series of physiochemical and toxicological parameters for each of the thirteen bandings. The significance of speciated TPH results can be assessed by following the 3 steps outlined in the below.

Step	Result	Action
1. Consider indicator compounds: Are BTEX, Naphthalene, Benzo(a)pyrene above their respective Tier 1 values?	Yes	Remediation or DQRA required
	No	Proceed to Step 2
2. Consider individual TPH fractions: are they above respective screening values?	Yes	Remediation or DQRA required
	No	Proceed to Step 3
3. Assess Cumulative effects: Is the calculated Hazard Index for each source >1	Yes	Remediation or DQRA required
	No	TPH compounds pose no significant risk

Step 1 *- Assessing indicator compounds*

TPH fraction Indicator compound	End use specific screening value (mg/kg)			
	A: Residential with produce	B: Residential without produce	C: Residential with POS	D: Commercial\ Industrial
Benzene	0.37	1.4	1.4	90
Toluene	660	3900	3900	180,000^{VAP} (4,360)
Ethyl Benzene	260	440	440	27,000^{VAP} (2,840)
Xylenes	310	430	430	30,000^{sol} (3,170)
Naphthalene	13	13	13	1,100

Step 2 *- Assessing individual TPH fractions*

TPH fraction		End use specific screening value S4UL (mg/kg) assuming 1% SOM				
		A	B	C	D	E
Aliphatic 5-6	GRO	42	42	5,000^	5,000^	5,000^
Aliphatic 6-8	GRO	100	100			
Aliphatic 8-10	GRO	27	27			
Aliphatic 10-12	DRO	130	130			
Aliphatic 12-16	DRO	1,100	1,100			
Aliphatic 16-21	DRO	5,000^	5,000^			
Aliphatic 21-35	LRO					
Aromatic 5-7	GRO	70	370			
Aromatic 7-8	GRO	130	860	1,000^	1,000^	1,000^
Aromatic 8-10	GRO	34	47	5,000^	5,000^	5,000^
Aromatic 10-12	DRO	74	250			
Aromatic 12-16	DRO	140	1,800			
Aromatic 16-21	DRO	260	1,900	3,800		
Aromatic 21-35	LRO	1,100	1,900			

^ Calculated Screening Value close to soil saturation limit, screening value selected by Calabrian considering visual and olfactory impacts.

S4UL LQM/CIEH S4UL adopted, 1% SOM

Step 3 *- Assessing Cumulative Effects*

$$HI = \sum_{F_i=1}^{16} HQ\ F_i = \frac{Measured\ concentration\ F_i\ (mg\,kg^{-1})}{SGV\ F_i\ (mg\,kg^{-1})}$$

where HI = Hazard Index
HQ = Hazard Quotient
F_i = Fraction $_i$
SGV = Soil Guideline Value

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCL Note 61/84 "Notes on the fire hazards of contaminated land" which states that:

"In general … it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn".

Tier 1 **groundwater** risk assessments are undertaken by comparing leachate or groundwater concentrations with the appropriate water quality standard. Tier 1 Screening Values have been discussed with the Environment Agency, and typically those in **bold** below are adopted.

Analyte	Source of Tier 1 Screening Value (µg/l)			
	Surface Water (Abstraction for Drinking) 1996	Water Supply Regulations. 2000	Water Framework Directive	Environment Agency Advice
Arsenic	50	10	**50**	
Selenium	10	**10**		
Cadmium	5	5	**1.5**	
Chromium	50	50	**32**	
Copper	50	2,000	**28**	
Lead	50	10	**7.2**	
Nickel		20	**20**	
Zinc	3,000		**125**	
Boron		**1,000**		
Mercury	1	1	**0.05**	
Polyromantic Hydrocarbons		0.01~	**0.002#**	
Petroleum Hydrocarbons				10
1,1,1-Trichloroethane			100	
1,1 Dichloroethane				100
1,2-Dichloroethane		3	10	
1,1-Dichloroethene				100
Benzene		1	10	
Ethylbenzene				10
Tetrachloroethene		10	10	
Toluene			50	
Trichloroethene		10	10	
Vinyl Chloride		0.5		
Trichloromethane			2.5	
Xylenes			30	
Chloroethane				**100**

~ sum of benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene

sum of Benzo(b)fluoranthene + Benzo(k)fluoranthene + Benzo(g,h,i)perylene + Indeno(1,2,3-cd)pyrene

Possible Action in event of Tier 1 exceedance

Should any of the Tier 1 criteria detailed above be exceeded, then three potential courses of action are available. (The first is only applicable in terms of human health, but the second and third could also be applied to groundwater or landfill gas).

1. Undertake further statistical analysis following the approach set out in "*Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration- CL:AIRE, 2020*" in order to determine whether contaminant concentrations of inorganic contaminants within soil\fill actually present a risk (only applicable to assessing the risk to human health).
2. Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.
3. Based on a qualitative risk assessment, advocate an appropriate level of remediation to "break" the pollutant linkage - for example the removal of the contaminated materials or the provision of a clean cover.

Prior to undertaking any statistical analysis the issue of the **averaging area** requires further consideration. The CL:AIRE\CIEH document still refers to CLR 7, which suggests averaging area should reflect receptor behaviour and therefore might be a single garden, or an open area used by the local community as a play area. This approach to averaging areas is considered applicable within the context of Part IIA of the Environmental Protection Act (EPA) 1990, in terms of an existing residential development.

However, Calabrian consider the concept of a single garden as an averaging area to be inappropriate with respect to brownfield redevelopment, which is regulated by the planning regime. In this context, contamination across the entire site needs to be characterised by reference to the Conceptual Site Model. Consequently, Calabrian gather and analyse sample results by fill type, and\or by former use in a given sub-area of the site, before undertaking statistical analysis; ie the averaging area is associated with the extent of a particular fill type, or an area affected by spillage\leakage.

In terms of brownfield redevelopment, this is considered a more appropriate methodology which provides a more representative sample population for statistical analysis. As such the entire site is considered in terms of the proposed end use, be this residential with, or without gardens.

Analysis by soil\fill type is appropriate for essentially immobile contaminants associated with a particular fill type, for example arsenic in colliery spoil, metals in ash & clinker, sulphate in plaster-rich demolition rubble etc.

Analysis by former use is appropriate where more mobile contaminants have entered the ground, for example diesel associated with leakage from a former fuel tank, downward migration of leachable metals through granular materials, various soluble contaminants present in a wastewater leaking into the ground via a fractured sewer etc. In these circumstances, it may be appropriate to undertake statistical analysis of sample results from a variety of different soil\fill types. However, consideration would have to be given to factors such as porosity which might influence impregnation of a mobile contaminant into the soil mass; ie contamination would normally be more pervasive and significant in granular soils than cohesive soils.

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APPENDIX C Visual Inspection of Gas Protection Measures

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VISUAL INSPECTION OF GAS PROTECTION MEASURES

Site name:	Gas characteristic situation:
Job number:	Type of development and building/block checked: (residential/
Date:	Building description:
Visit by:	Foundation type: (suspended floor/raft/other)
Weather at time of inspection:	Gas protection type: passive/active

No.	Item	Comments (see notes)
1 Gas membrane		
1.1	Condition of sub-grade and underside of gas	
1.2	Gas membrane type	
1.3	Gas membrane condition	
1.4	Joining tape product	
1.5	Lapping design	
1.6	Laps, welds and joints seals	
1.7	Service entries seals	
2 Passive venting		
2.1	Sub-floor void	
2.2	External wall airbricks	
2.3	Internal sleeper walls	
2.4	External vent trenches/ducts	
3 Active venting		
3.1	System details	
Additional notes:		

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Notes: inspection checklist

1.1	Underside of gas membrane	Check that the sub grade does not contain rough/uneven surfaces, is appropriately clean and that there are no hard/sharp objects. That protective sand blinding or geotextile (if specified) is present and meets the design criteria.
1.2	Gas membrane type	Manufacturer and product specification, gauge, colour, brand/name, material batch/roll numbers, storage arrangements (protected from dirt/damage?)
1.3	Gas membrane condition	Open punctures, tears, rips, stretching? Excessive footprints/evidence of traffic? Presence of debris? Repairs? Signs of weakness such as raised or sunken indentations? Protection plan in place to restrict access to lain gas membrane?
1.4	Joining tape product	Product type, brand, thickness, material, width, colour? Use of double-sided tape?
1.5	Lapping design	Joints lapped and sealed in accordance with manufacturer's requirements/ specification? Minimum overlap insured? Sections taped twice?
1.6	Laps and joints sealed	Welds complete? Appropriate joining/double sided tape used?
1.7	Service entries sealed	Top hats seal arrangements fixed around service entries? Use of Jubilee clips?
2.1	Sub-floor void	Is a check possible? Void former? Gravel (type/specification)? Height of void space? Is it clear?
2.2	External wall airbricks	Numbers, size, positions as design drawing?
2.3	Internal sleeper walls	Ventilation holes (honeycomb brickwork/pipe crossings?) – size, spacing, location in accordance with design?
2.4	External vent trenches/ducts	Located and constructed in accordance with design drawings? If open-topped gravel – gravel type/presence of fines? If pipe or other vent, check position and construction for functionality and absence of blockages. Ability of void former to withstand bearing of the superstructure?
3.1	Active venting	Type of air supply: mechanical, natural, combined? Location/condition/number of fans and vents? Location and size of inlets? Provision of air-cleaning devices and air heaters? Supply and exhaust ductwork? Alarm provision/installation? Gas monitoring system in under-floor void?

Photographs

No.	**Description**

The gas protection measures inspected:	a Are acceptable and comply with the specification
	b Are acceptable but attention is drawn to issues related to item no. xxx
	c Are not acceptable due to the issues related to item no. xxx

Name: **Signature:** **Date:**

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Civic Engineers

Job Title
Upper Brook Street, Manchester

Report Type
RIBA Stage 2 – Civil and Structural Report

Prepared for
McLaren Property

Date
5 May 2023

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Appendix A – A2 Phase 1 Site Investigation Report

Appendix B – Cornerstone Utilities Survey Report

Appendix C – CCTV Survey Report and Drawing

Appendix D – Drainage Strategy Options Drawings and FRA

Appendix E – Structural Framing Options Drawings

Appendix F – Cantilever Study Sketchbook

Appendix G – Low Carbon Concrete Savings Calculation

RIBA Stage 2 – Civil and Structural Report

Prepared by	**Nick Healy**
Reviewed by	Tomasz Lukaszewicz
Civic Job No.	2584
Issued	05.05.23
Revised	P03 – Updated Structure design, drainage strategy and FRA

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1. Introduction

This report has been prepared by Civic Engineers on behalf of McLaren Property Ltd. and Kadans Science Partner, to support a full planning application for a Sci-Tech and purpose-built student accommodation scheme (PBSA) scheme (hereafter referred to as the 'Proposed Development') on Phase One of the Upper Brook Street Masterplan (hereafter referred to as the 'Site'). This scheme would bring forward development on a previously developed site which is earmarked for commercial and PBSA uses in the Oxford Road Corridor SRFG 2019. This application has been accompanied by a suite of technical documents, reports and plans.



Figure 1 - Sheppard Robson architectural proposal received 29/03/23

1.1 Project Team

Civic Engineers have been appointed by McLaren Property, alongside Sheppard Robson as Architects and Lead Consultant, to provide Civil and Structural Engineering, and Transport consultant services for the proposed Upper Brook Street development. The project team members include:

Client: McLaren Property

Civic & Structural Engineer: Civic Engineers

Transport Engineer: Civic Engineers

MEP Services Engineer: Cundall

Landscape Architect: Re-Form

Fire Engineer: Cundall

Façade Consultant: TBC

Planning Consultant: Avison Young

Project Manager: Burofour

Quantity Surveyor: Abacus

1.2 Project Brief

The project brief was initially set out by McLaren Property and has been further developed through the Stage 2 process. This project, alongside the adjoining Sci-Tech form Phase 1 of the Upper Brook Street Masterplan. Phase 2 of the Upper Brook Street Masterplan is being brought forward by Property Alliance Group and Moda Living. The masterplan intends to transform the currently vacant sites, re-establishing their important role in the area by re-introducing permeability, public realm, and active community-facing uses at ground floor. The emerging masterplan includes over 2 acres of new public realm and green spaces, a new public square, as well as a series of high-quality new buildings of varying heights to provide for approximately 700,000ft2 of sci-tech accommodation, 1,800 purpose-built student accommodation beds, and 25,000ft2 of active ground floor uses. The PBSA proposals for Phase 1 of the Upper Brook Street Masterplan include the construction of the following:

- 2No student residential buildings (a single 9 to 23 storey block comprising circa 737 apartments, with a first floor terrace.)
- Landscaped public realm space encompassing the buildings including SUDS features.

The adjoining Sci-Tech Building does not form part of this report. However, scope for a number of surveys including CCTV, GPR and Ground Investigation survey has extended to both sites at the request of the client for practicality and will be noted at the relevant sections within this report.

2. Site Analysis

2.1 Site History

Historic maps dating back to the early 1900's suggest that much of the site's history was previously a residential development until the mid-20th century. Light industrial units then followed in the site's history up to the current day.

Refer to A2 Site Investigation's Phase 1 Report (Appendix A) for site history table from 1848 to 1978. See Figure 2 below of a historic map of the site dated 1888-1913 and historic aerial photograph from above date 1937.

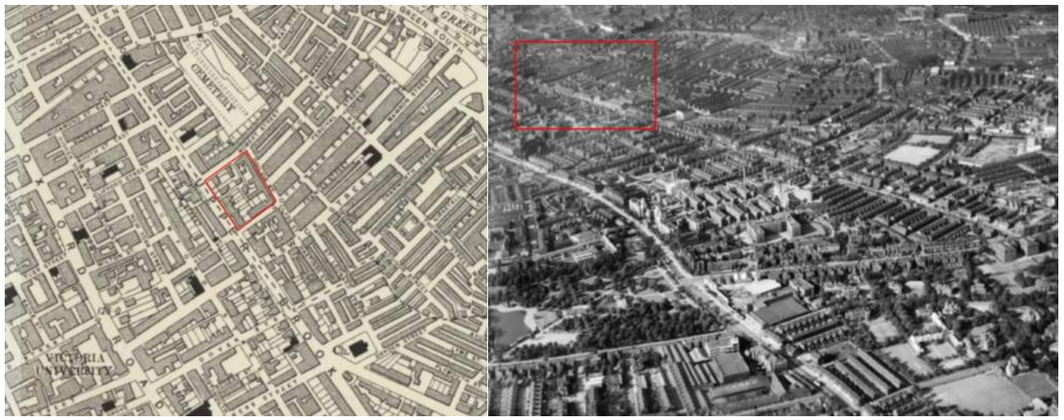


Figure 2 - (Left) historic map of site dated 1888-1913, (right) historic aerial photo of site dated 1937

2.2 Current Site and Proposals

The proposed site is located at 53-57 Upper Brook Street (A34), Manchester, directly opposite the Alan Turing Building and the Manchester Institute for Mathematics. To the east of the site is the residential street Kincardine Road and Ardwick.

There are two developments proposed within the overall site, with the second site (site 2, refer to Figure 3) adjacent to the south along Upper Brook Street. Both sites are adjoined via public realm spaces at ground level, which allow foot travel from Upper Brook Street through to Kincardine Road. This report focuses on Site 1 shown in Figure 3. Current proposals from Sheppard Robson include a 737-bed student residential scheme comprising 2no rectangular (on plan) buildings. The larger tower facing Upper Brook Street is 23-storeys tall and the smaller facing Kincardine Rd is 9-storeys tall. The two towers are connected centrally via a 1-storey high podium.

The site was previously Citroen car dealership which closed permanently circa 2017. The dealership building is unoccupied, however, outdoor space within the site boundaries that was previously used to store and exhibit cars is now a Pay & Display car park operated by SiP. The existing 1-storey building on site appears to be of steel portal framed construction with block masonry infill walls. From desk study research it is understood that the existing building does not have a basement, but this will need to be confirmed upon gaining access to the interior of existing steel structure. The existing building will be demolished to make way for the new development.

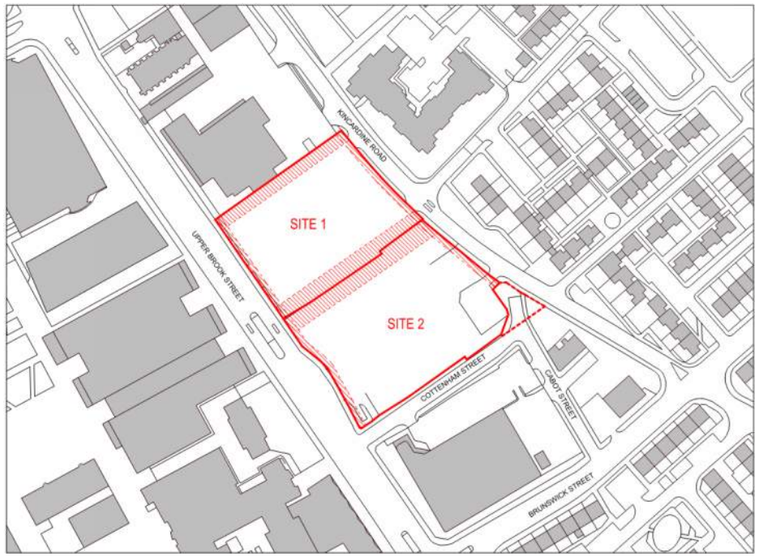


Figure 3 - Sites 1 & 2 location and red line boundary

2.3 Adjacent Site – Sci-Tech Building

There is a 13,800m² six to nine storey office and lab building neighbouring with the proposed McLaren student residential towers to the south which is being brought forward by Kadans Science Partner. McLaren and Kadans are to provide a coordinated landscape design for both projects to allow for seamless transition between two developments. As part of the development of both schemes it is proposed to conduct several site investigations such as geo-environmental, topography, and CCTV surveys, covering both sites simultaneously. Civic Engineers have led the coordination of the surveys for both sites.

Landscape architects Re-form have developed proposals to create Thorburn Walk, a new pedestrian and cycle route with communal dwelling space between the PBSA building and the Sci-Tech building. The concept for the passageway is to cater for both groups, students, and employees at the science centre, to allow them to share the common area and to improve the permeability of the area between the University Buildings and Ardwick.

Re-form have provided a preliminary drawing with external levels to allow for drainage strategy and flood risk assessment studies to progress further. Along Thorburn Walk it can be noted from the drawing above that each site drains away from each other, which allows a separate drainage strategy to be developed for each project. However, it is the intention of the design teams on each project to share certain elements of the drainage strategy, such as permeable paving to achieve cohesions of the shared pubic realm space.

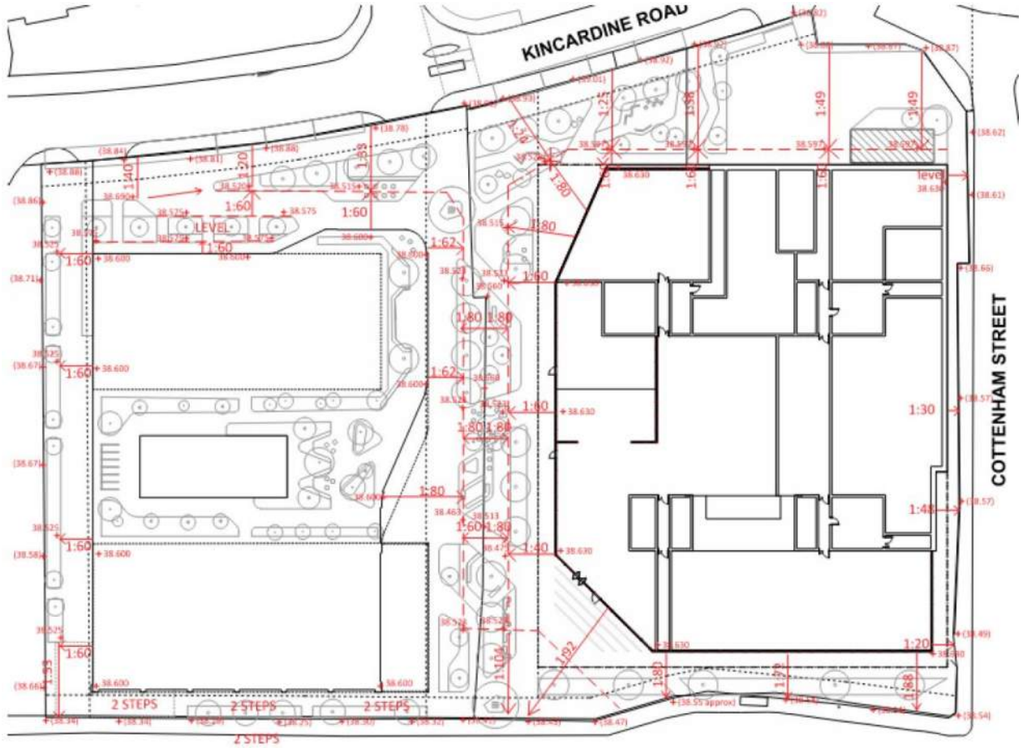


Figure 4 - Student Residential and Kadans external levels (Re-form)

2.4 Visual Survey

On the 4th of October 2022, Civic Engineers conducted an on-site visual survey. At the time of this report, access into the existing Citroen dealership building was not available.

A walk-around visual survey of the existing car park revealed no structure or historic repair works that would indicate a risk of hinderance or potential engineering challenges. Topography of the car park and surrounding area was relatively flat, with no major cracks found within the pavement that could have resulted from a high amount of ground settlement, for example.

To the front of the proposed Sci-Tech Building along Upper Brook Street are several electrical service boxes and what appears to be two large cellular (mobile phone) reception towers. It is likely that it will be necessary to relocate these cellular towers for the Sci-Tech Building to avoid in-ground clashes and visual intrusions. Although these aren't anticipated to affect the PBSA site which is the focus of this report, it is worth noting for future works.



Figure 5 - Site photograph taken from Upper Brook Street facing northeast.



Figure 6 - Site photograph taken from rear of the site facing south

3. Surveys

3.1 Utility Searches

A utility search was carried out by Cornerstone Project Ltd on behalf of Civic Engineers, dated 24/11/22, to identify buried services present around the site which could inform or impact the design as per Sheppard Robson concept proposals.

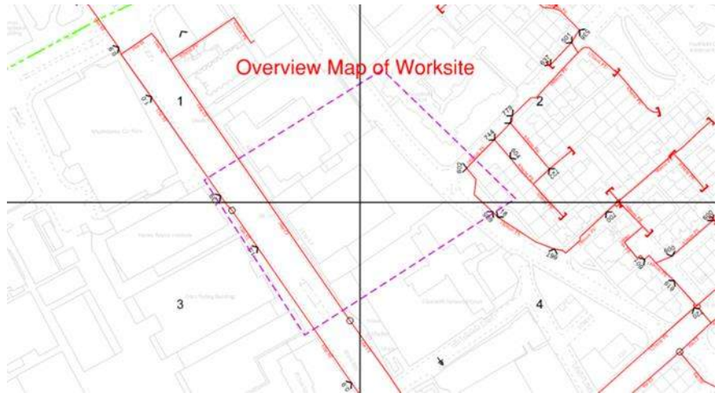
The following searches were carried out:

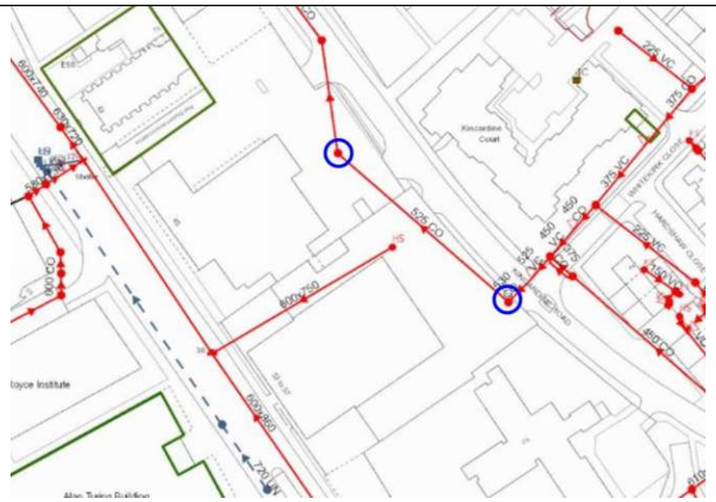
- Gas
- Sewage
- Water
- British Telecom
- Electricity
- Third Party
- Comms Cable
- Independent Utilities

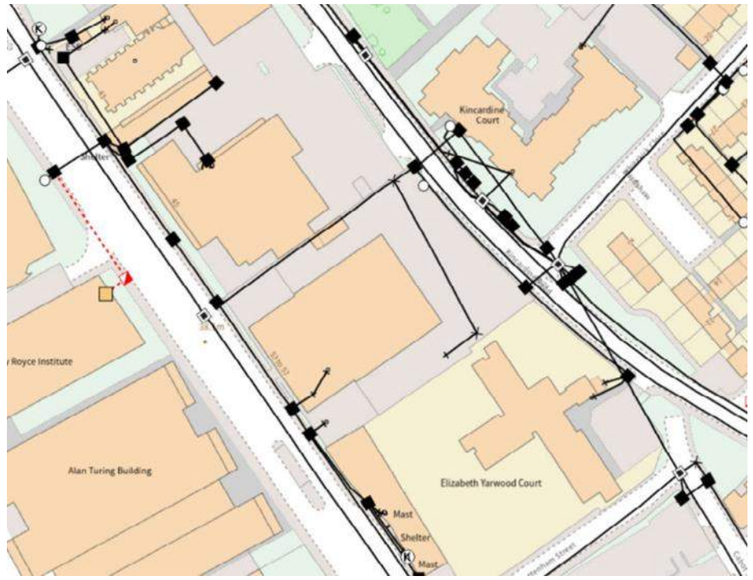
Refer to Table 1 for a summary of the above utility searches and associated site plans. Refer to Appendix B for the full Cornerstone Utilities Search Report.

Services location shown are based on the desktop study utility search results and are indicative only. For final locations of underground services, refer to the CCTV survey results in Section 3.2 of this report.

Table 1 – Utilities Searches

Gas	A low pressure, 14inch cast iron mains pipe to the south perimeter of the site along the A34. Civic are liaising with the gas supplier to understand requirement easement distance. 
Sewage	Two combined public sewers within site boundary. 600x750 public sewer starting in the northwest corner of the site, running south and connecting to a 600x860 combined public sewer along the A34. It is thought that this run serviced the existing building. The existing sewer will likely be disconnected and removed during the ground works for the new building. 530 concrete combined public sewer pipe running along Whitekirk Close, north of the site, connecting to a 525 dia concrete combined public sewer pipe which enters into the site boundary at the northeast corner. Sewer pipe runs through the northern side of the site and exits through the west site boundary. Results from the CCTV survey has confirmed that the location shown in the Utilities Search result is not accurate, and the sewer line is further back than shown below and located along the Kincardine Boundary line. Refer to Section 3.2 for details.

	
Water	4inch asbestos-cement distribution main running along the A34 to the front of the site. 15inch cast-iron pipe running along Kincardine Road to the rear of the site. 
British Telecom	Live line along the A34 with 3 boxes along the site boundary to the front, with a connecting live line into the existing building. Live line along Kincardine Road with 2 boxes along the site boundary to the rear.

	Live line along the west site boundary and a connecting live line through the rear of the site that stretches the width of the property. 
Electricity	6kV-6.6kV and low volt electric cables running along the east site boundary, connecting to cables of the same voltage along the A34. 
Third Party	1No euNetworks duct running along the A34 to the front of the site.

	1No euNetworks long haul (LHN) duct running along Kincardine Road to the rear of the site.
Cable	1No Vodafone cable connecting to the west side of the existing building, running north along the west side of the property, and connecting to a Vodafone cable along Kincardine Road. 1No Virgin Media cable running along Kincardine Road to the rear of the site. 1No Virgin Media chamber to the southeast corner of the site. 1No Colt infrastructure network running along the A34 to the front of the site. 1No Neos Networks underground route running along Kincardine Road to the rear of the site. 1No CityFibre plant running along the A34 to the front of the site.
Independent Utilities	None found in the vicinity of the area.

3.2 CCTV and GPR.

A CCTV and GPR survey are required to inform the student accommodation buildings and public realm design constraints. Civic Engineers were requested to expand the scope of the CCTV and GPR survey to cover the full application site (i.e. where the PBSA and Sci-tech building will be located) on the 24/11/22.

Information required as part of the scope:

- Report identifying sewers existing condition.
- Manhole (MH) cards for each MH. Northing, easting, ILs, CLs of each feature (using GPS equipment).
- Provision of Jetvac unit.
- Dwg (CAD) of sewers identified showing existing routes.

On the 06/12/22, Layer Surveys LTD were appointed for the CCTV survey and completed works on the 30/01/23. Critical services to the project that were found are as follows:

100mm Surface Water Sewer running along the east and rear of the site and appears to be the main source of surface water facilitation off the site. These pipes connect to a 600mm Combined Water Sewer that runs east to west of the site along Kincardine Road. This sewer pipe was previously thought to have been entering into the north side of the site and exiting through the west from the utilities survey. However, the CCTV has confirmed that the pipe is located further back and along the Kincardine Boundary line. United Utilities have confirmed that the required easement of the sewer is 4m either side of the centreline of the sewer.

The CCTV survey found a water main pipe to the east of the existing building that connects through to the adjacent property. It has been confirmed that there are water mains running along both Upper Brook Street and Kincardine Road from the utilities survey. Due to the proximity of the Upper Brook Street water mains line and the location of the water main found within the site boundary, it is believed that the water mains connect at the Upper Brook Street side.

Electric cables have been located to the east and west side of the existing building and an unidentified gas service to the west of the site. Several unidentified services/features determined from GPR contacts have been identified around the site, however, it is not believed that they will have a significant impact to the current development proposals.

See Figure 7 - CCTV survey overlay plan for a plan of the critical services. For the full CCTV survey drawing and accompanying report, refer to Appendix C.

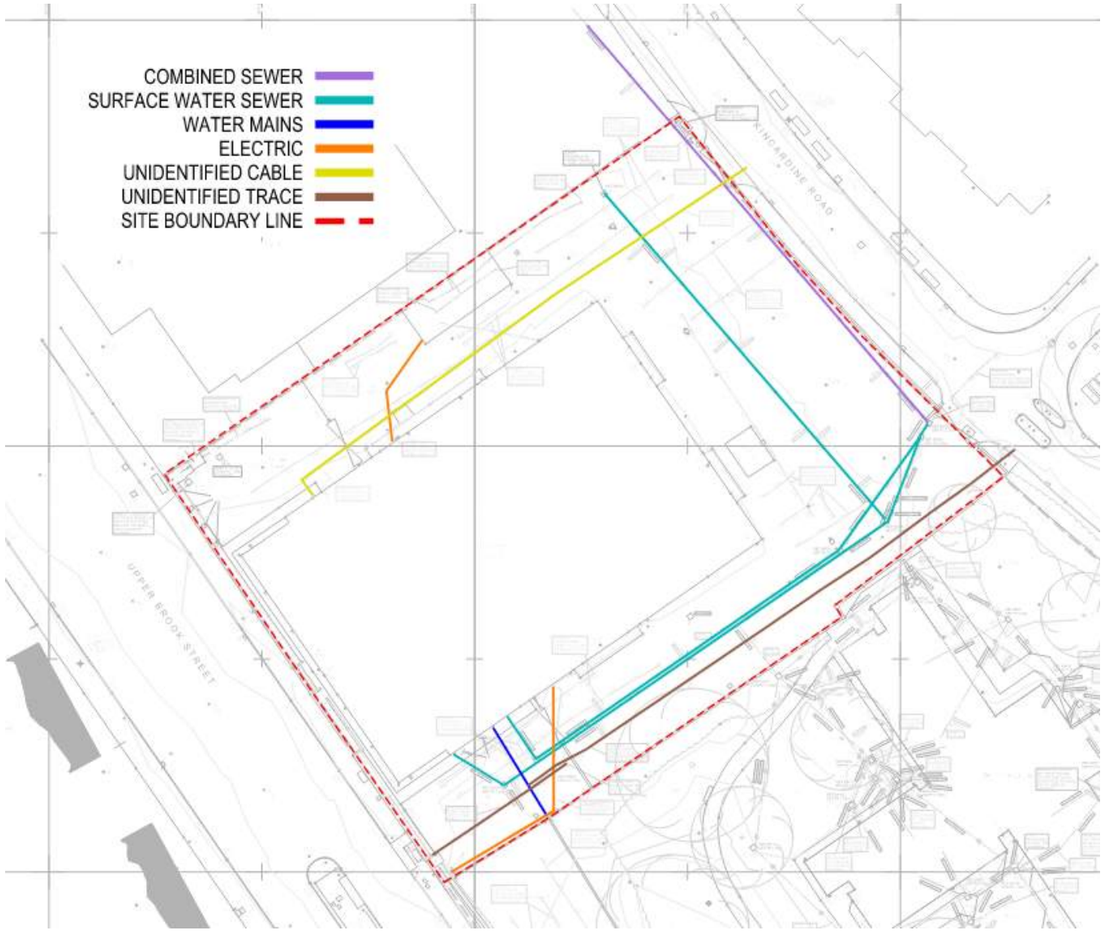


Figure 7 - CCTV survey overlay plan

3.3 Ground Investigation

A ground investigation is required to provide site-specific ground information to inform the sub-structure design. Civic Engineers produced the scope of works for both Phase 1 and Phase 2 Geo-Environmental Ground Investigation in November 2022. The scope of works covers the entire planning application site.

Scope for the Phase 1 – Preliminary Risk Assessment includes the collation of information of the existing site:

- Site setting & Description
- Site History
- Geology
- Soil Geochemistry
- Hydrogeology & Hydrology
- Flood Risk
- Analyse any potential sources of contamination and determine the contamination risk

Phase 2 GI scope includes intrusive investigation techniques, and the scope is as follows:

- Provide a standard suite of geotechnical and geo-environmental testing
- Produce an interpretative report including safe bearing pressures and shear strength and indicative Pile length

Site constraints have been outlined alongside the scope of works, and includes pile rig access into the existing building, potential slab in the existing building and any nearby underground services.

3.4 Phase 1 Preliminary Risk Assessment Report

On the 27/03/23 A2 Site Investigation attended site to conduct a visual survey of the existing site. On the 06/04/23 the final Phase 1 Preliminary Risk Assessment Report was submitted, and the following information was identified. Refer to Appendix A for Phase 1 Report.

Phase 2 intrusive investigation works have not yet been carried out. It is advised that these works should be completed prior to RIBA Stage 3 design commencing to de-risk the proposed foundation solution.

3.4.1 Geology

Manchester geology typically comprises of a complex mixture of numerous bedrock formations, In the surrounding area of the site, the following formations can typically be found:

In order of increasing depth:

- Chester Pebble Beds Formation, reddish brown, moderately cemented sandstones deposited during the Triassic period, forming part of the Sherwood Sandstone Group.
- Manchester Maris Formation, deposited in the upper Permian period.
- Collyhurst Sandstone Formation, red-brown sandstone deposited during the Lower Permian period.
- Pennine Upper Coal Measures Formation – mudstone, siltstone and sandstone. Sedimentary bedrock formed during the Carboniferous period.

Geology maps (see Figure 8) and ground conditions at site indicate the presence of Made Ground overlying glacial till superficial deposits and Chester Formation bedrock. The site history and historical boreholes suggest that Made Ground is of variable thickness across the site.

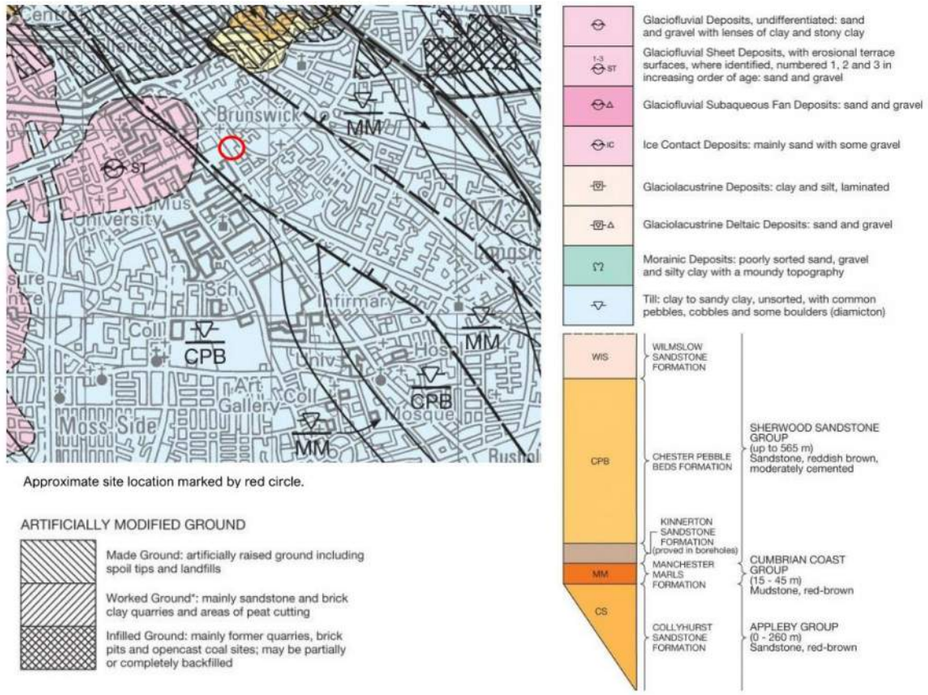


Figure 8 - Site geology map extract

Historic borehole logs from the British Geological Survey (BGS) dating back to 1970 indicate that the ground profile on the site is typically made up of the following stratum:

- Made Ground (0-1.5m)
- Glacial Till (1.5-4.0m)
- Sherwood Sandstone Group: Chester Formation (4.0m - >)

3.4.2 UXO Assessment

A 'low to moderate' level of bomb damage was identified for the project site from a preliminary UXO assessment. It is recommended that a detailed UXO threat and risk assessment be carried out. This will inform if any mitigation measures are required for future works and if a UXO specialist is to be engaged to provide appropriate mitigation measures during the construction phase of works.

3.4.3 Asbestos

Asbestos containing materials may be present in the current building fabric, the risk of which is currently unknown. The risk represented by potential ACMs can be addressed by commissioning an asbestos Demolition and Refurbishment Survey for the existing building.

3.4.4 Hydrogeology and Hydrology

Historical BGS boreholes of the surrounding area suggest that groundwater is to be expected to rest between 8.0 – 12.0m bgl depending on seasonal conditions. Groundwater monitoring in previous nearby site developments indicate no shallow groundwater table as all boreholes monitored were dry.

The Chester Formation expected beneath the site is classified as a Principal bedrock Aquifer and has the potential to used as a source of drinkable water. However, there are no groundwater abstractions within 500m of the site boundary.

Alluvium is expected be present on site due to the historical Corn Brook River being approx. 50m south of the site,

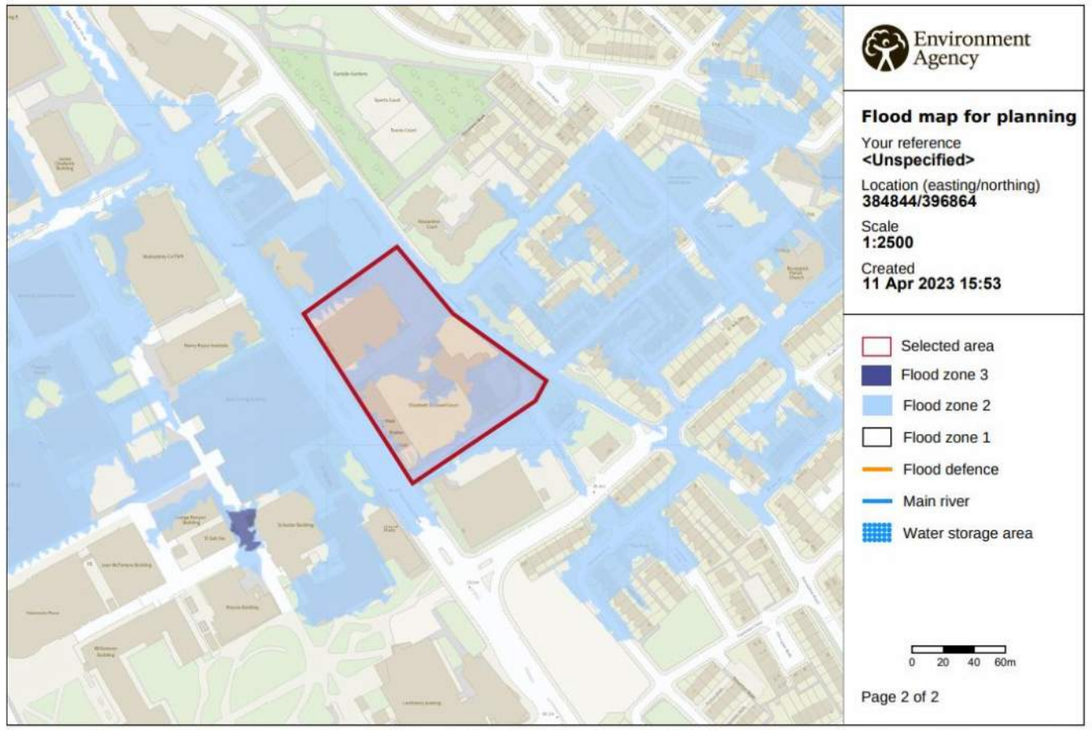
There are no surface water features or surface water abstractions within 500m of the site boundary.

3.4.5 Flood Risk

The site is classified as having a 'limited potential' for groundwater flooding to occur.

Flood Maps for Planning indicate that the site is located in Flood Zone II. The site is marked as having a medium probability of flooding from rivers and sea, with 0.1-1% chance of flooding from rivers and .1-0.5% chance of flooding from the sea.

A flood risk assessment is required as part of the planning application for this development. Refer to Section 4 of this report for the flood risk assessment details.



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Figure 9 - Environment Agency Floor Map for Planning extract

3.4.6 Radon

UK Health Security Agency and BGS radon mapping indicates that the site is in an area with less than 1% of homes estimated to be at or above action level.

As there is no basement within proposals for the development, no further radon assessment is required, and no protection needs to be incorporated into the proposed building fabric.

3.4.7 Contamination

Potential contaminant linkages with a maximum 'low to moderate' risk classification have been identified. Based on the results of the preliminary Risk Assessment, it is considered that unacceptable risks are present, and a ground investigation is recommended to confirm and itemise these. A targeted ground investigation should be conducted for geo-environmental purposes to refine the conceptual site model and geo-environmental assets. The next stage geo-environmental should include a generic quantitative risk assessment.

4. Drainage Summary

4.1 Flood Risk Assessment

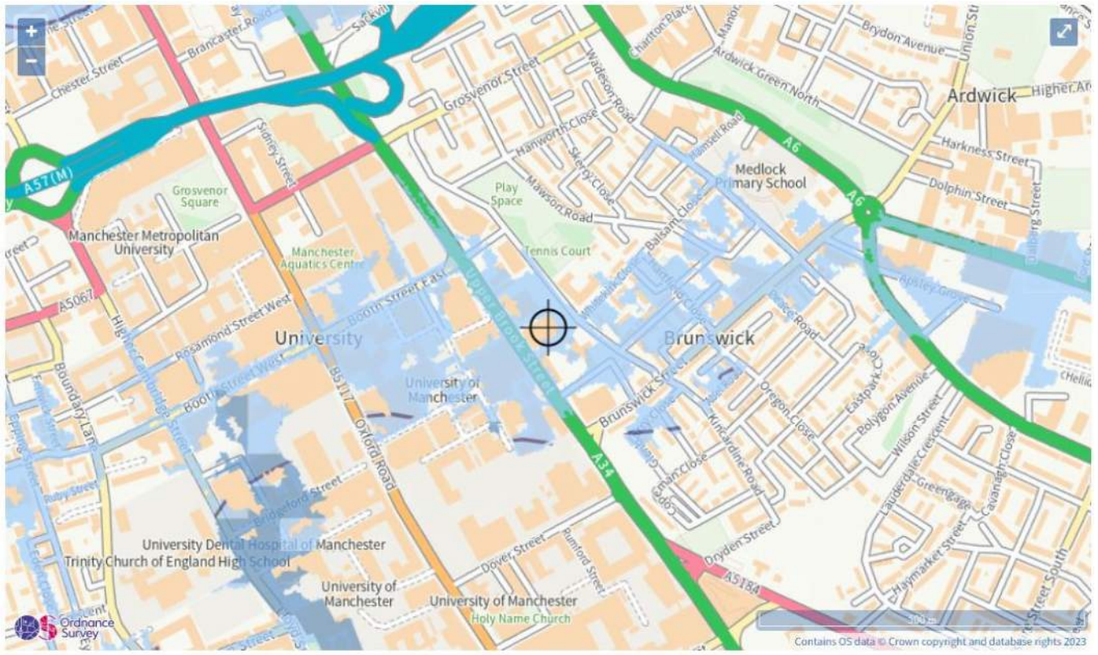
The potential sources of flooding to the proposed development have been assessed and are discussed below.

4.2 Tidal/ Fluvial Flooding (Rivers and Sea)

From the Government flood map for planning:

- Where a site is located in a dark blue shaded zone, this indicates that the site is within Flood Zone 3 where there is a chance of flooding of 1 in 100 (1%) or greater.
- Where a site is located in a light blue shaded zone; this indicates that the site is within Flood Zone 2 where there is a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%).
- Where a site is located in a white (unshaded) area, it is generally deemed to be classified as Flood Zone 1 where there is a chance of flooding of less than 1 in 1000 (0.1%).

The 'Flood Map for Planning', shown in Figure 10 indicates a medium probability of annual flooding from rivers and sea. The proposed developments ground floor level will be built up from the flood levels of the site. This will reduce the risk of flooding from rivers and sea to low.



Extent of flooding from rivers or the sea

Figure 10: Flood Risk Map from rivers or sea

4.3 Reservoir Flooding

Reservoir flooding is extremely unlikely to happen and there has been no recorded loss of life in the UK from reservoir flooding since 1925. The Environment Agency is the enforcement authority and ensures that reservoirs are inspected regularly, and essential safety work is carried out.

4.4 Groundwater Flooding

The EA magic map for ground vulnerability suggest that the site is located in an area considered to be at medium to low risk of groundwater vulnerability.

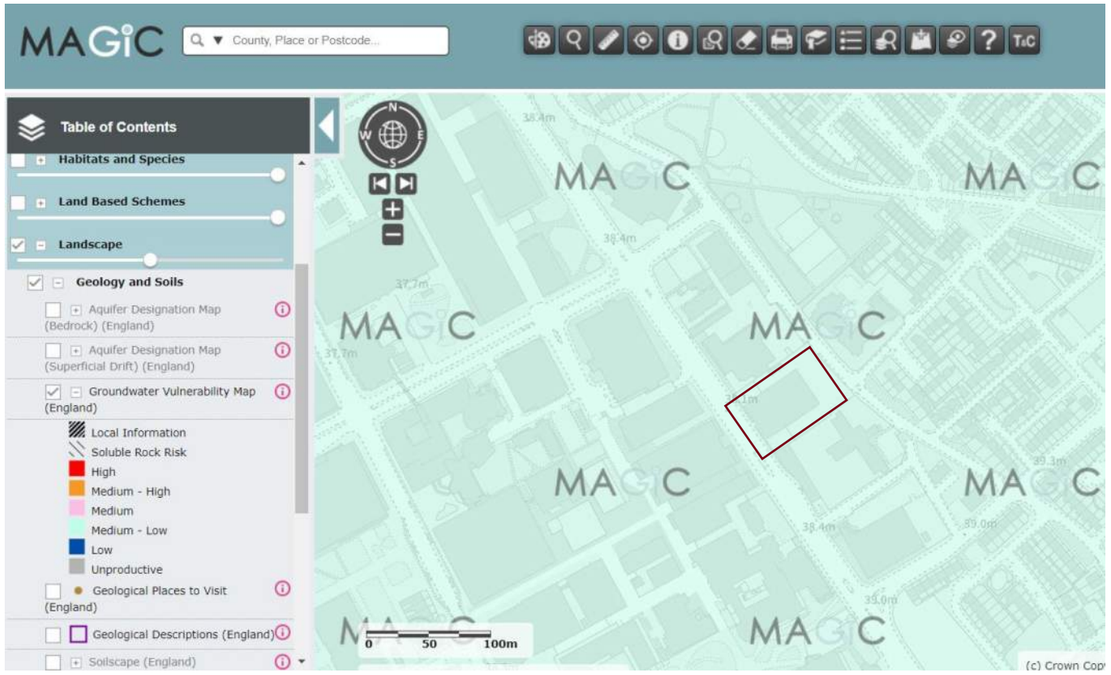


Figure 11: EA Magic Map, Groundwater Vulnerability Extract

4.5 Public Sewers, Highway Drainage Flooding, and Infrastructure Failure

UU are unable to disclose if there has been previous flooding of their assets within the vicinity of the site. In following the SuDS Hierarchy, if it is deemed necessary to connect to the existing UU network, UU have recommended keeping the proposed network shallow and backdropping into the existing network.

Providing United Utilities and Manchester City Council maintain their drainage assets in the surrounding area of the site, the risk of flooding to the proposed development site from public sewer or highway drainage is low.

4.6 Surface Water Flooding to the side

Surface water flooding can be caused when rainwater, during extreme rainfall events, does not drain away through the normal drainage system or soak into the ground. Surcharging sewers can result in overland flows which if originating at a higher elevation than a development site can potentially pose a flood risk.

Surface water flooding is dependant primarily on topography which dictates either the flow path of overland flow which is not contained within public sewers, or areas in which ponding may occur. Surface water flooding is more difficult to predict than the risk of flooding from Rivers or Sea as it is dependent on the amount of rain which will fall in a very localised area, the specific topography of that region and the capacity and functionality of the drainage network within that section.

From the UK Government's Flood Risk from Surface Water (extent of flooding) map:

- Where a site is in a dark blue shaded zone, this indicates that the site is at high risk of flooding where there is a chance of flooding of greater than 1 in 30 (3.3%).
- Where a site is in a mid-blue shaded zone, this indicates that the site is at medium risk of flooding where there is a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).
- Where a site is in a light blue shaded zone; this indicates that the site is at low risk of flooding where there is a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%).
- Where a site is in a white (unshaded) area; this indicates that the site is at very low risk of flooding where there is a chance of flooding of less than 1 in 1000 (0.1%).

The extent of flooding to the site from surface water is indicated in Figure 12. It shows the majority of the site to be at low/very low risk with areas of medium risk of flooding from surface water between the proposed PBSA and Sci Tech sites.

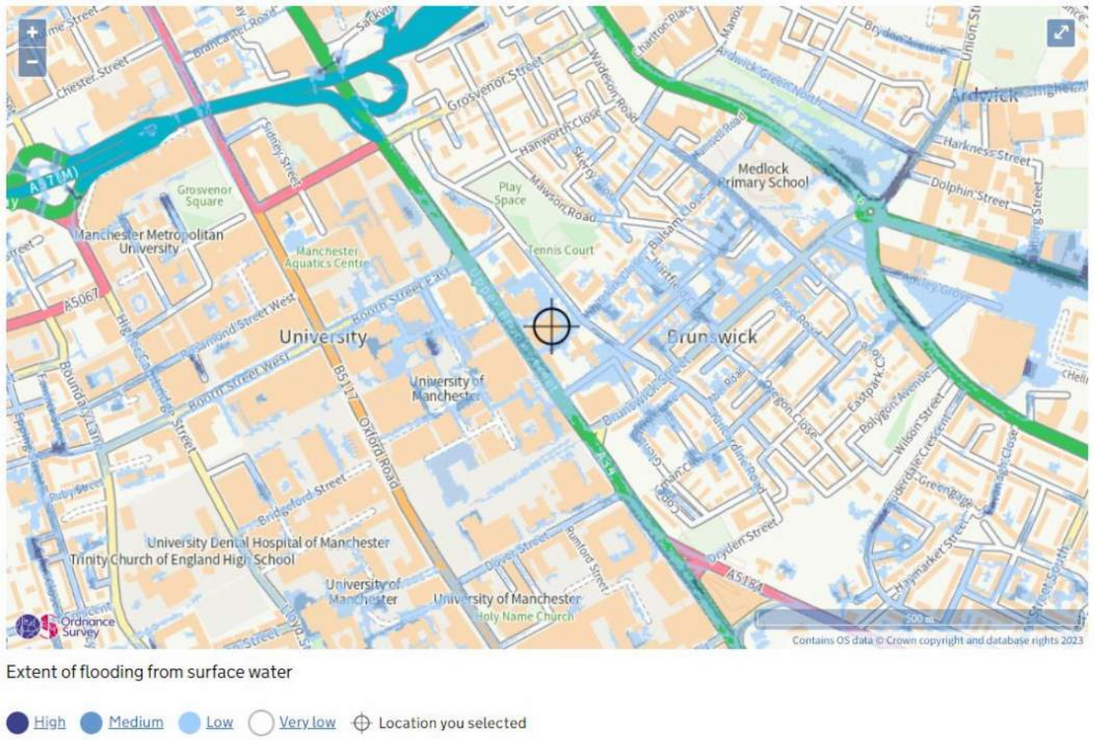


Figure 12: Surface Water Flood Risk Map

4.7 Surface Water Flooding from the Site

Developers are responsible for ensuring that a new development does not increase the flood risk elsewhere. The proposed surface water drainage network shall be designed to not flood for the critical 1 in 30-year storm event and flood water generated up to the critical 1 in 100-year plus climate change storm event shall be constrained within areas on site so as not to cause damage to buildings, essential services or adjoining developments and services.

With the addition of soft planted areas, the proposed site has a reduced impermeable area of 11% compared to the existing site as you can see in Table 2.

Table 2 Site impermeable areas

	Existing	Proposed	Change
State Impermeable Area (Ha)	0.45Ha	0.40 Ha	-0.05 Ha

4.8 Summary of Flood Risk

From the evidence collated and subsequent negotiations, the flood risk proposed to the development can be summarised as follows:

- Rivers and Sea – Low risk
- Reservoir – Low Risk
- Groundwater – Medium/Low risk
- Public Sewers – Low risk
- Surface Water – Very Low Risk/Low/Medium

5. Surface Water Management Strategy

5.1 Existing Site/Pre-development Runoff

The existing drainage around the development includes a public combined network along the front and rear of the site within Upper Brook Street and Kincardine Road. Within the site is a private surface water network. A CCTV survey carried out by Layer Surveys indicated the existing runs to be in a good condition but not all the runs were able to be surveyed.

5.2 Drainage Hierarchy Points of Discharge

The NPPF Planning Practice Guidance Paragraph 080 states that:

"Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

1. into the ground (infiltration).
2. to a surface water body.
3. to a surface water sewer, highway drain, or another drainage system.
4. to a combined sewer."

Infiltration Potential Sustainable Drainage Systems (SuDS) Features to be Considered.

Infiltration tests are being carried out on site at the time of writing this report to confirm if infiltration is feasible. Due to the presence of made ground it is likely that infiltration won't be feasible.

Water Body

The nearest main river is located 610m north of the site. This is a direct route cutting through existing buildings. Due to the route and the distance, connecting to the river Medlock is not feasible.

There is also an existing culvert located approximately 140m south of the site. A discharge rate of 5ls to the culvert has been agreed by UU. An enquiry to the LLFA has been submitted to confirm the location and feasibility of connecting to the culvert. Response is pending at time of issue.

Surface Water Sewer

There is a highway drain situated within Upper Brook Street, indicated on the sewer records. Highways have confirmed we cannot connect to their system (response received on 12.01.23)

There is also an existing private surface water network within the site. The existing conditions and levels indicate reuse of the network could be a possibility. However, the network connects to the combined manhole located in the eastern corner of the site.

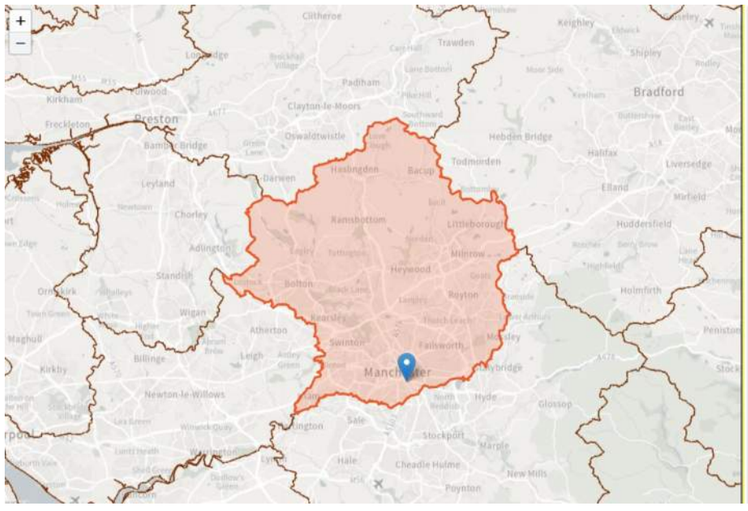
Combined Sewer

Two public manholes are located within and on the boundary of the site. UU have confirmed connection to the manholes for foul water and for surface water, if connection to the culvert is ruled out, at a rate of 26l/s.

5.3 Proposed Surface Water Drainage Design

As the development was previously developed, surface water drainage from the site will be restricted such that it does not exceed the pre-development run off rates, with the aim of achieving at least a 50% reduction in accordance with the recommendations as set out in the Manchester, Salford & Trafford SFRA. However, in addition to this requirement, guidance within the northwest SuDS proforma, introduces a requirement to achieve greenfield run-off rates where a site is to be developed entirely, even if classified as brownfield.

In February 2016, the Environment Agency released updated climate change allowances for peak rainfall intensities which should be applied to new developments. Figure 13 demonstrates the climate change allowances with central and upper end allowances being considered.



Irwell Management Catchment peak rainfall allowances

3.3% annual exceedance rainfall event

Epoch	Central allowance	Upper end allowance
2050s	25%	35%
2070s	30%	40%

1% annual exceedance rainfall event

Epoch	Central allowance	Upper end allowance
2050s	25%	40%
2070s	30%	45%

Figure 13: Climate change allowances for peak rainfall intensities for the site

Based on the nature of the development, a lifespan in excess of 60 years is anticipated. The potential climate change allowance for 2070 an onwards ranges between 30% for the central allowance and 45%. For the upper end allowance. As such the design will consider an allowance of 45% climate change on peak rainfall intensity calculations.

It is proposed to restrict the surface water runoff rate to greenfield in order to discharge to the culvert. 5l/s for the 100 year + 45% climate change allowance has been proposed to reduce the risk of blockages within the system. Approval from the LLFA is still required as we wait for a response.

Based on this requirement, surface water storage features will need to be designed to accommodate the restricted surface water flows. These will be in the form of permeable paving and an attenuation tank designed in accordance with CIRIA suds manual.

The necessary on-site attenuation volume in order to achieve the restricted rate of 5l/s is:

1. 154 m^3 Storage provided by the permeable paving.
2. 101 m^3 storage provided by an attenuation tank.

A drainage strategy has been produced showing indicative drainage connection points and layouts incorporating attenuation. It can be found within Appendix C, along with the proposed catchment plan.

5.4 Sustainable Urban Drainage Systems (SuDS)

Where possible the site drainage will look to utilise SuDS features. Section 1.1 of the SuDS Manual (Ciria C753) states the following:

> *"Sustainable drainage systems (SuDS) can deliver multiple benefits.*
>
> *Surface water is a valuable resource, and this should be reflected in the way it is managed and used in the built environment. It can add to and enhance biodiversity, beauty, tranquillity and the natural aesthetic of buildings, places and landscapes and it can help make them more resilient to the changing climate.*
>
> *The philosophy of sustainable drainage systems is about maximising the benefits and minimising the negative impacts of surface water run-off from developed areas.*
>
> *The SuDS approach involves slowing down and reducing the quantity of surface water runoff from a developed area to manage downstream flood risk and reducing the risk of that runoff causing pollution. This is achieved by harvesting, infiltrating, slowing, storing, conveying and treating runoff on site and, where possible, on the surface rather than underground. Water then becomes a much more visible and tangible part of the built environment, which can be enjoyed by everyone."*

The SuDS Manual describes the four pillars of SuDS design as Water Quality, Water Quantity, Amenity and Biodiversity as illustrated in Figure 14.

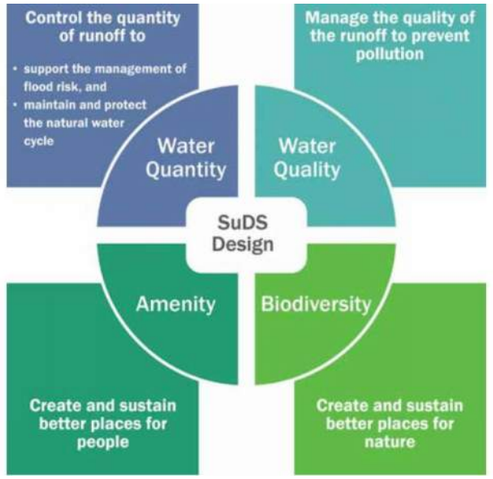


Figure 14: Sustainability Development Objectives (Representation of figure 2.1 of the SuDS Manual)

Where possible SuDS are to be incorporated into the post development design to reduce the surface water run-off rates. Various SuDS methods have been summarised in **Error! Reference source not found.** below to assess and establish which are most feasible for the proposed post development site.

Table 3: SuDS Sustainability Assessment

Feature	Type	Advantages with this site
Currently Proposed		
Permeable Paving	At Surface	Permeable Paving removes the requirement to provide entry points (gullies etc.), provides pollution treatment and allows water to be stored within aggregate sub-base.
Tanked/Geocellular Attenuation systems	Below Ground	Tanked attenuation systems provide high storage capacity and can be incorporated within road pavements and under landscaping
To Be Considered		
Basins and Ponds – Above Ground storage	At Surface	Basins and ponds increase biodiversity and amenity of the area; provide attenuation; and improve water quality. This method does occupy large areas of developable land and needs to be constructed at the lower levels of the site. Due to the flat topography and minimal external space, basins and ponds are unlikely to be feasible with the site proposals.
Swales	At Surface	Swales can be used adjacent to any impervious surfaces to collect surface water run off at source. They also provide additional benefits such as amenity and biodiversity opportunities
Green roofs	Above Ground	Green roofs would provide a simple solution to the requirement of surface water attenuation for the site. They could form part of the building structure and store any runoff from the large roofs. Generally, they also provide benefits such as energy saving in terms of temperature control within buildings, noise reduction, biodiversity, and improved air quality. They also have the ability to remove up to 80% of rainwater through evapotranspiration.
Blue Roofs	Above Ground	Blue roofs have the availability to potentially store higher volumes than green roofs.
Rain Gardens	At surface	Rain Gardens provide amenity, biodiversity, treatment, and small amounts of attenuation benefits.
Tree pits	At surface	Tree pits provide amenity, biodiversity, treatment, and small amounts of attenuation benefits.

The surface water run-off from the site will be from roofs and residential streets and as such the risk of contamination and suspended silts/debris being present within surface water will be low.

Maintenance of SuDS will be the responsibility of the developer/operator of the development.

5.5 Water Quality Assessment

The SuDS design for the development site will ensure that the quality of any receiving water body is not adversely affected and preferably enhanced in accordance with CIRIA SuDS Manual C753, Chapter 4. The "CIRIA SuDS Manual (C753) Simple Index Approach to Proprietary/ Manufactured Stormwater Treatment Devices" will be used to show that the proposed SuDS features will provide adequate water treatment in terms of total suspended solids (TSS), hydrocarbons and metals.

	Mitigation indices[1]		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Notes

1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.

2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.

3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.

4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.

5 See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: **http://tinyurl.com/qf7yuj7**

6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Notes

1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).

2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

The above figures have been extracted from the CIRIA Report C753 Suds Manual to assess the pollution indices relative to the proposed development. Given the proposed development use is classified as residential, the corresponding pollution hazard level is determined to be 'low'.

Assessments have been carried out to determine SuDS pollution mitigation indices for the TSS, metals and hydrocarbons for the proposed development. In order to deliver suitable treatment, selected SuDS components should have a total pollution index that equals or exceeds the pollution hazard index.

i.e. Total SuDS mitigation index ≥ pollutions hazard index.

Total SuDs mitigation index = mitigation index, + 0.5 (mitigation index)

As previously discussed, the proposed attenuation features for this development are an attenuation tank and permeable paving.

The SuDS pollution mitigation for the proposed permeable paving has been evaluated in the tables below.

SuDS mitigation indices for discharge to surface water (TTS)		Total SuDS mitigation index	Pollution hazard indices For different land use Classification (Low) TTS (≥0.5)
			≥0.5
Permeable Paving	0.7	0.7	✓

SuDS mitigation indices for discharge to surface water (Metal)		Total SuDS mitigation index	Pollution hazard indices For different land use Classification (Low) Metals (≥0.4)
			≥0.4
Permeable Paving	0.6	0.6	✓

SuDS mitigation indices for discharge to surface water (Hydrocarbons)		Total SuDS mitigation index	Pollution hazard indices For different land use Classification (Low) Hydrocarbons (≥0.4)
			≥0.4
Permeable Paving	0.7	0.7	✓

6. Proposed Foul Water Drainage

Foul water drainage disposal is set out in Part H of the Building Regulations in order of priority the preferred methods are;

1. Public sewer

2. Septic tank

3. Cesspool.

The foul water system shall be designed in accordance with;

- BS EN 752:2008 (Drain and sewer systems outside buildings)
- Sewers for Adoption (6th Edition)
- Technical Guidance to the National Planning Policy Framework document (Department for Communities and Local Government, March 2012).
- BS EN 12056-2:2000 (Drainage systems inside buildings)
- Building Regulations Approved Document H, Drainage and waste disposal. (Office of the Deputy Prime Minister, December 2010).

Any connection to the public sewer is subject to formal agreement with United Utilities under Section 106 of the Water Industry Act 1991.

UU have confirmed their preferred points of connection for the foul water drainage to be either the combined manhole located within the eastern corner of the site or the combined manhole within Upper Brook Street. The connection point will be confirmed once the layout is finalised.

7. Drainage Summary

The site currently hosts a vacant car dealership building, the outdoor space within the property that was previously used to store and exhibit cars is now a Pay & Display car park owned by SiP.

From research attained by the British Geological Survey website, borehole data from within the site suggests the below ground strata consists of deep made ground and sandstone.

The development is located within Flood Zone 2 and is within the low-risk area for reservoir, groundwater, public sewers and surface water flooding. Flood level data has been requested from the EA, results are pending at time of issue.

Form the evidence collated, the summary of flood risk to the site is as follows:

- Rivers and Sea – Low risk
- Reservoir – Low Risk
- Groundwater – Medium/Low risk
- Public Sewers – Low risk
- Surface Water – Very Low Risk/Low/Medium

The site impermeable area will be reduced from 0.45Ha to 0.40Ha with the addition of soft landscape areas.

Confirmation on the feasibility of infiltration will be finalised upon receipt of the intrusive ground investigations.

A discharge rate of 5l/s has been proposed and approved by UU to discharge surface water to the culvert. The proposed discharge rate is yet to be agreed with the LLFA.

If connection into the culvert is not feasible, UU have provisionally accepted 26l/s into the combine water sewer located nearby.

8. Structural Scheme

8.1 Initial Structural Optioneering

During RIBA Stage 2, Civic Engineers have carried out an optioneering study for the structural framing of the proposed student accommodation buildings. In-situ reinforced concrete and precast reinforced concrete were primarily considered within the framing study.

Structural steel framing was considered during RIBA Stage 1, but was discounted due to large structural depths, lack of inherent fire protection, poor acoustic performance, and lack of alignment between steel frame and cellular pods. Refer to 2584 - Upper Brook St McLaren - RIBA Stage 1 Report Rev P02 for details.

The key items of which Civic Engineers used to compare structural solutions are as follows:

Efficiency of Structural Design

Efficient structural solutions have a positive impact on cost and programme as well as reducing unnecessary waste when accounting for the whole life cycle of the project. Efficiency of the structural grid and buildability are both to be considered as a key driver of the proposed solution.

Design Flexibility

Flexibility within the structural framing to adapt to future changes to the scheme layout has been considered, as well as to achieve open-spaces free of structural elements.

Suitability of Materials and Embodied Carbon

The materials selected to construct the structural framing that best meets the use and frame of the project. The choice of material can also dramatically impact embodied carbon and the resulting footprint of the development. Consideration is given to the entire life cycle of the material from procurement to end-of-life, as per the circular economy systemic approach.

For the purposes of consideration in this report, the development has been grouped into two building types:

- 9 Storey
- 23 Storey

Refer to Appendix E for indicative structural plans.

8.2 Scheme Massing Development

From RIBA Stage 1 to Stage 2 the scheme massing has developed from two L-shaped accommodation buildings, ranging from 5 to 21 storeys to the current two rectangular shaped accommodation buildings, ranging from 9 to 23 storeys. See Figure 15 for the previous and current scheme development.

Changes in the overall building frame have resulted in a redeveloped proposed grid. The structural considerations have therefore been adapted to the updated envelope from Phase 1. Studies into materials and construction techniques are still valid due to the intended use and cellular nature of the structure remaining unchanged.



Figure 15 - Architectural layout development from Stage 1 to Stage 2

8.3 Preferred Scheme: In-Situ Reinforced Concrete Frame

The preferred structural framing option at RIBA Stage 2 is an in-situ reinforced concrete frame. The design comprises of approximately 250mm thick flat slabs (or 220mm post-tension slabs) supported vertically by in situ RC columns and RC core.

Structural load paths are as follows:

- Lateral loads including wind and notional horizontal loads are applied to the structure and transferred by vertically spanning facade elements into the RC flat slabs.
- RC flat slabs act as stiff diaphragms and distribute loads to core walls.
- Core walls experience loads from RC slabs and act as a large vertical cantilever box resisting lateral loading and transferring them into the foundations.

Lateral stability is provided by central RC cores, with walls initially sized at 250mm thick for the 9-story and 300-400mm thick for the 23-storey frame. Some walls will reduce in thickness at the upper levels. To accommodate openings within the RC core walls, RC coupling beams are shown to link walls over openings. These transfer shear and bending across openings and combine walls to act as a single element. See section 8.4 for further lateral stability analysis.

The columns are place on a typical approximately 6.5m x 6.5m grid (although this increases to approx. 7.5m x 7.5m in a few locations to satisfy the architectural layout). Columns are proposed to be square columns from ground to first floor and change blade columns above to fit within the depth of student apartment partitions. Blade columns reduce in section size as the building increases in height, starting at 275 x 1650mm at first floor through to 225 x 900mm at top four floors:

9 STOREY COLUMN SIZE REDUCTION TABLE	
FLOORS	BLADE COLUMN SIZE
5 - 9	225x900mm
0 - 4	250x1000mm

23 STOREY COLUMN SIZE REDUCTION TABLE	
FLOORS	BLADE COLUMN SIZE
20 - 23	225x900mm
15 - 19	250x1000mm
10 - 14	250x1200mm
5 - 9	250x1400mm
0 - 4	275x1650mm

Figure 16 - Column size reduction table from structural sketches

Viable green credentials for the development were examined to achieve current standards set by BREEAM with new builds. Opportunities are available for the use of low carbon concrete in RC slabs, columns, and walls. Refer to Section 10 for the low carbon concrete study.

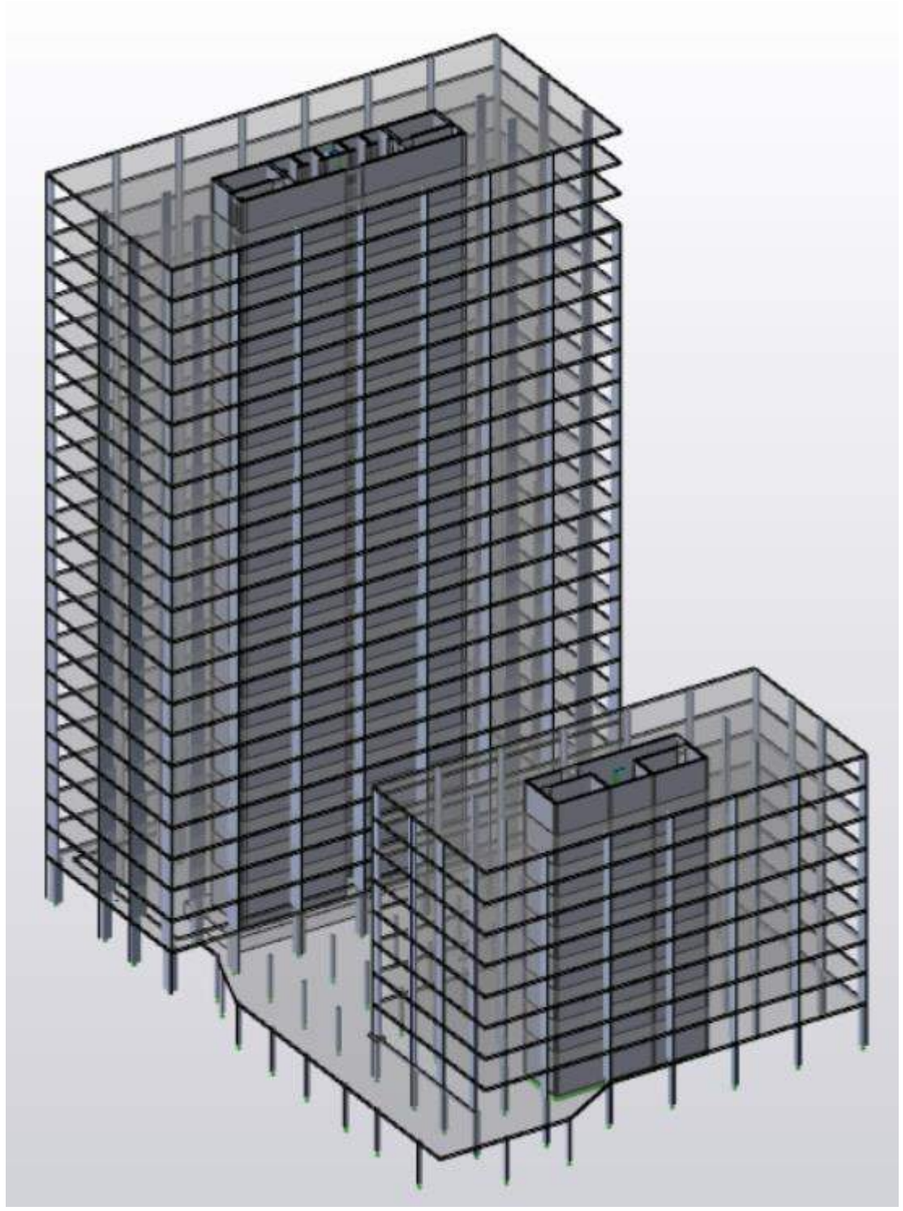


Figure 17 - RC In-Situ frame structural model

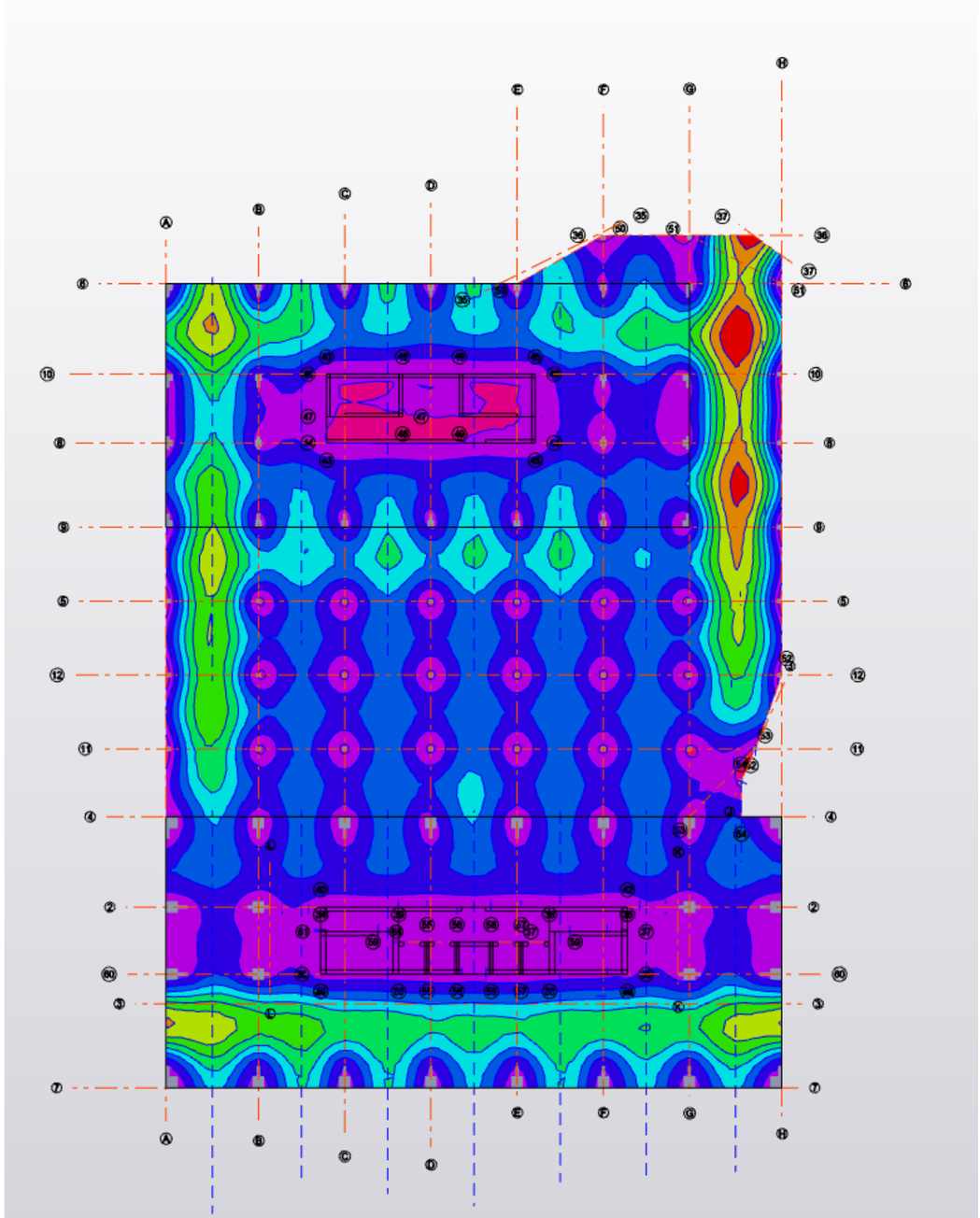


Figure 18 - First floor terrace slab deflection modelling

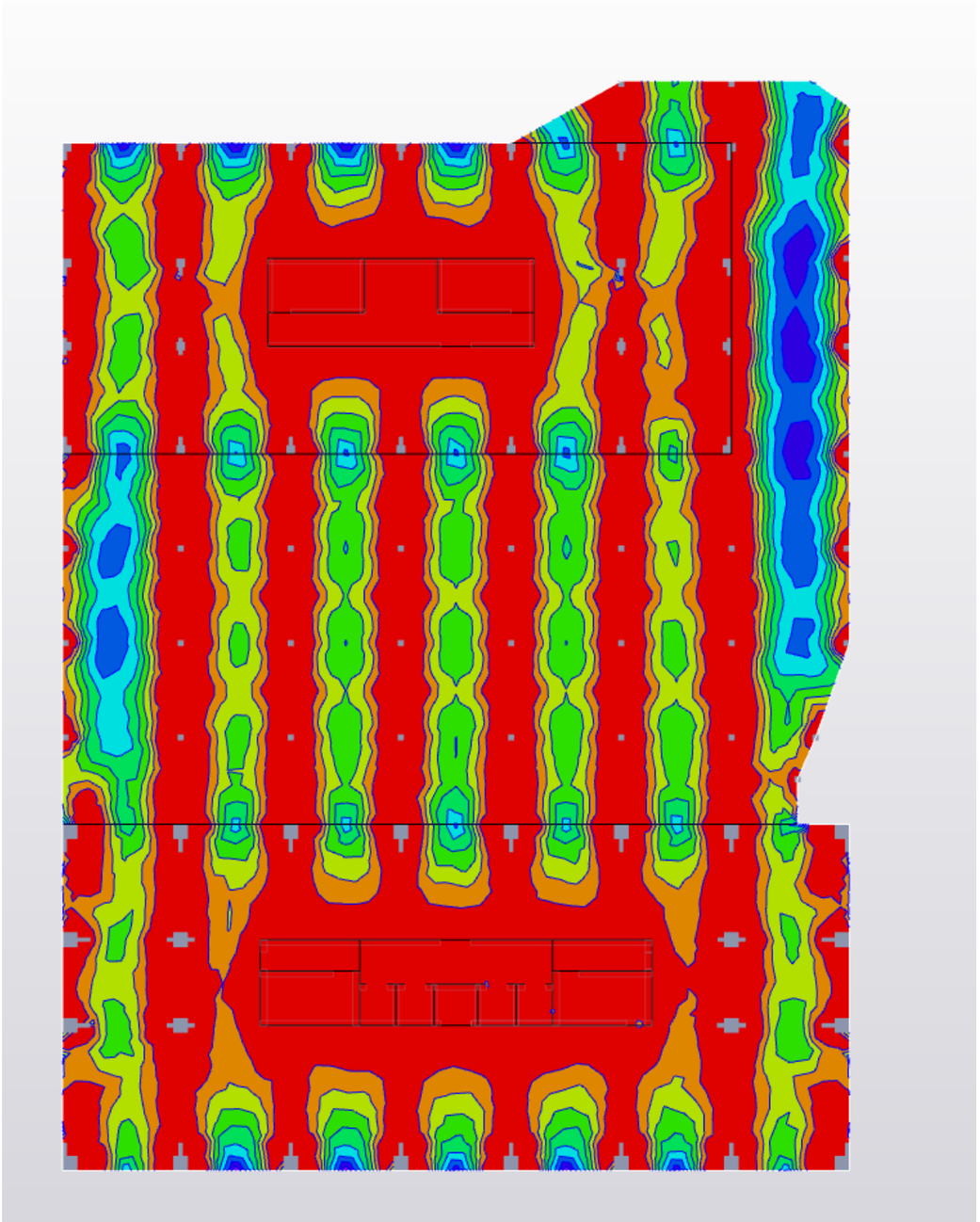


Figure 19 - First floor terrace slab moment output

8.4 Lateral Stability Analysis

Lateral stability is provided by the central RC cores within both the 9-storey and 23-storey residential towers. Two directions of wind are considered for initial lateral stability checks, Dir 1 +/- and Dir 2 +/- (See Figure 20 for wind directions in relation to plan).

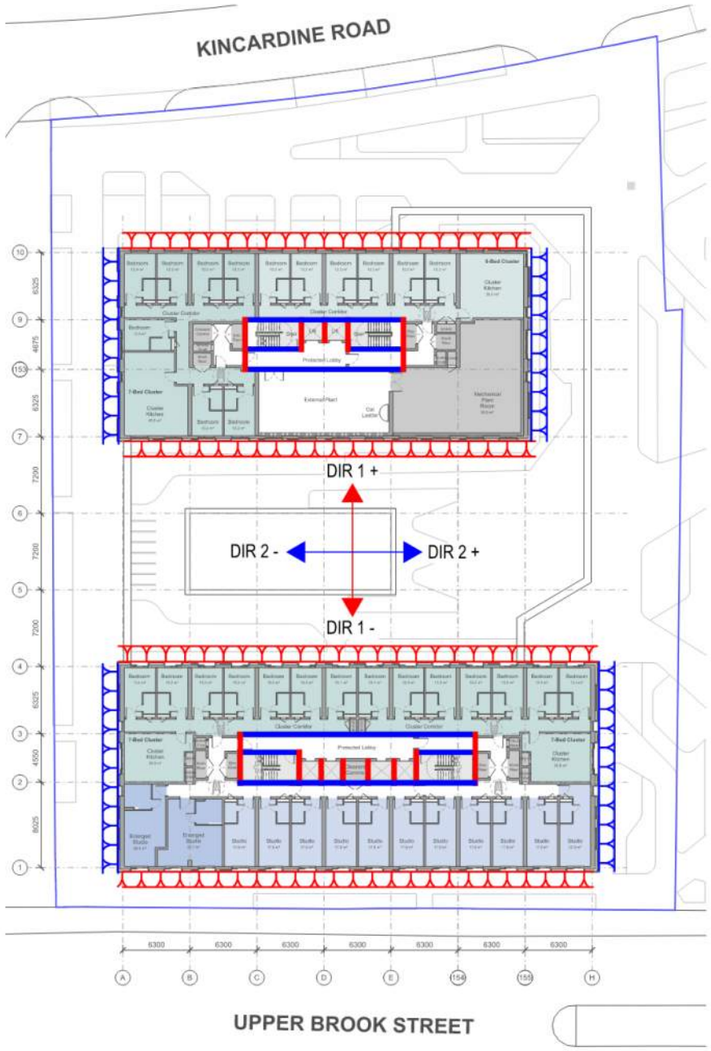


Figure 20 - Wind loading plan

Core walls indicated in red are resisting wind in Dir 1 +/- and walls indicated in blue are resisting wind in Dir 2 +/-. Due to the overall shape of the structure, the core walls receiving the greatest wind loading from Dir 1 +/- also have the shortest total length of resisting return walls. This puts higher stress in the slender core direction and therefore results in the requirement for thicker walls in the critical wind direction.

Comparing the overall height of the cores in relation to its width in both wind directions provides a slenderness ratio that indicates geometrical lateral resistance. As the 23-storey building attract far more lateral force than the 9-storey frame, it's core is subjected to much higher internal shear, compression, and tension forces. See Figure 21 for 3D model analysis showing stress in the two residential tower cores.

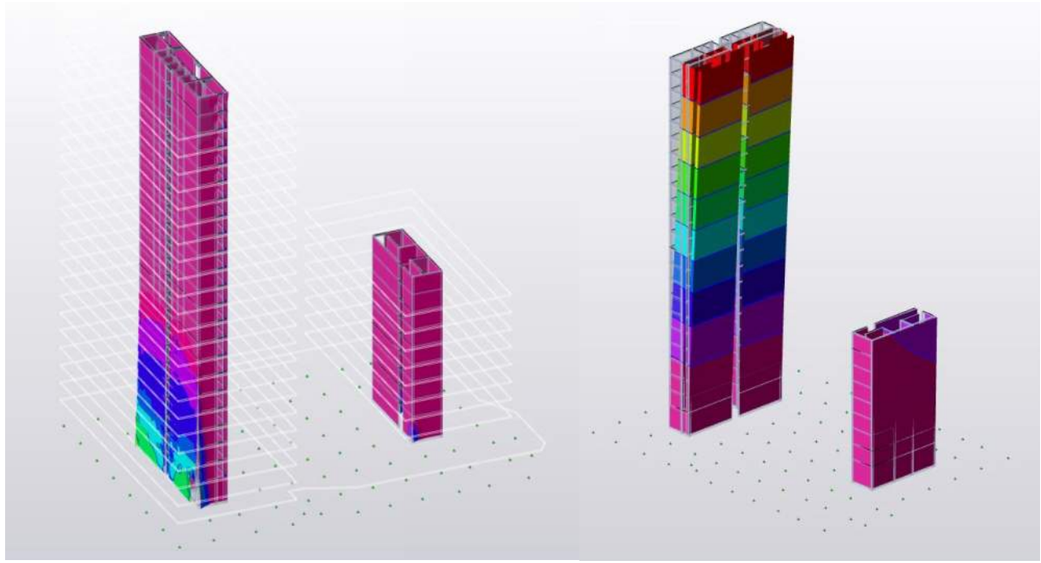


Figure 21 - (Left) Core stress output. (Right) Core deflection output

The central cores are required to resist displacement for stability as well as preventing damage to structural and superficial elements. External façades with sensitive finishes are assumed to require horizontal deflections to be under the ratio: height/500 to prevent damages incurred from excessive displacement. To satisfy the H/500 sway requirement, the 23-storey tower walls were sized as follows:

Dir 1 +/- 400mm & Dir 2 +/- 300mm. The 9-Storey tower was subject to lower stress and deflection demand. Therefore, the walls were sized as follows: Dir 1 +/- 250mm & Dir 2 +/- 250mm. The larger 300-400mm walls are expected to incrementally reduce in thickens with the increase in heigh of the building. Detailed design o be developed at RIBA Stage 3.

The lateral stability analysis on the 23 storey tower indicated that the proposed framing works close to its sway limit. The anticipated deflection on top of the tower in critical wind direction (Dir 1) is approximately 130mm, whilst the allowable limit of H/500 is 140mm. This is due to the large lateral force concentration on a relatively low volume of shear walls in Dir 1 on.

A preliminary assessment of wind loads experienced by the respective cores has been derived using the applicable Code of Practice, BSEN 1991-1-4:2005: Actions on Structures – General actions – Wind Actions. These loads are assessed within the structural analytical model for means of preliminary/initial analysis only at this stage and are to be considered further by means of wind tunnel testing by a specialist during RIBA Stage 3. Further review will be required following the results of the wind modelling analysis. Refined wind loading parameters which result from the wind tunnel testing may aid in the reduction of wind pressures and therefore loadings and may result in reduced walls thickness from those initially calculated. This exercise of core rationalisation will be carried out following the wind tunnel test data during Stage 3.

8.5 Natural Frequency / Vibration of Concrete Frame

The proposed Architectural layout results in a relatively slender structure in the principal wind direction. The building height to core wall length ratio (aspect ratio) of 74m/5m = 14.8. Whilst the analysis performed for the 23-storey tower under preliminary lateral wind loads present anticipated horizontal deflections within limits of H/500, the high aspect ratio should be investigated further in terms natural frequency period.

Based on the research paper by the Council on Tall Buildings and Urban Habitat *'Relationship between Natural Vibration Periods and Structural heights for High-rise Buildings in China'*, 2014, the period (inverse of natural frequency) will reflect the characteristics of the structure and determine whether the structure can satisfy the requirements of codes on high-rise buildings, such as stability, story drift limit etc.

For buildings between 50m and 100m tall, the desirable fundamental period is defined by the following formula $T_1 = 0.15\sqrt{H} \sim 0.3\sqrt{H} = 1.3s \sim 2.6s$ or **0.38Hz ~ 0.77Hz** natural frequency range.

The preliminary modal analysis performed on the 23-storey tower resulted in the fundamental frequency of 0.3Hz. This suggest that the structure is slender and corresponds to the high aspect ratio.

Mode Number	Period [sec]	Frequency [Hz]	Error [%]	Mass Participation Dir 1 [%]	Mass Participation Dir 2 [%]	Mass Participation Z [%]	Modal Mass [kN]
1	3.892	0.3	0.00	0.00	53.33	0.00	68717.4
2	2.306	0.4	0.00	1.92	0.00	0.00	28999.4
3	1.246	0.8	0.00	1.36	5.12	0.00	5247.3
4	1.148	0.9	0.00	50.74	0.03	0.00	68078.9
5	0.805	1.2	0.00	0.47	23.24	0.00	13419.9
6	0.738	1.4	0.00	0.28	0.07	0.00	13665.8
7	0.655	1.5	0.00	0.73	0.04	0.00	25375.4
8	0.423	2.4	0.00	0.00	0.00	0.05	163.1
9	0.422	2.4	0.00	0.00	0.00	0.11	121.1
10	0.422	2.4	0.00	0.00	0.00	0.15	123.1

Figure 22 - Modal analysis results

Although unlikely, it is possible, that the detailed lateral stability analysis followed by the results of the wind tunnel tests, may results in a need for additional lateral stability walls. As such, Civic Engineers have made an allowance for 2no additional shear walls shown in Figure 23.

Once further detailed input and data is received following the wind tunnel testing, we will be able to further review the natural frequency/vibration effects and relative stiffnesses of the core walls during RIBA Stage 3.

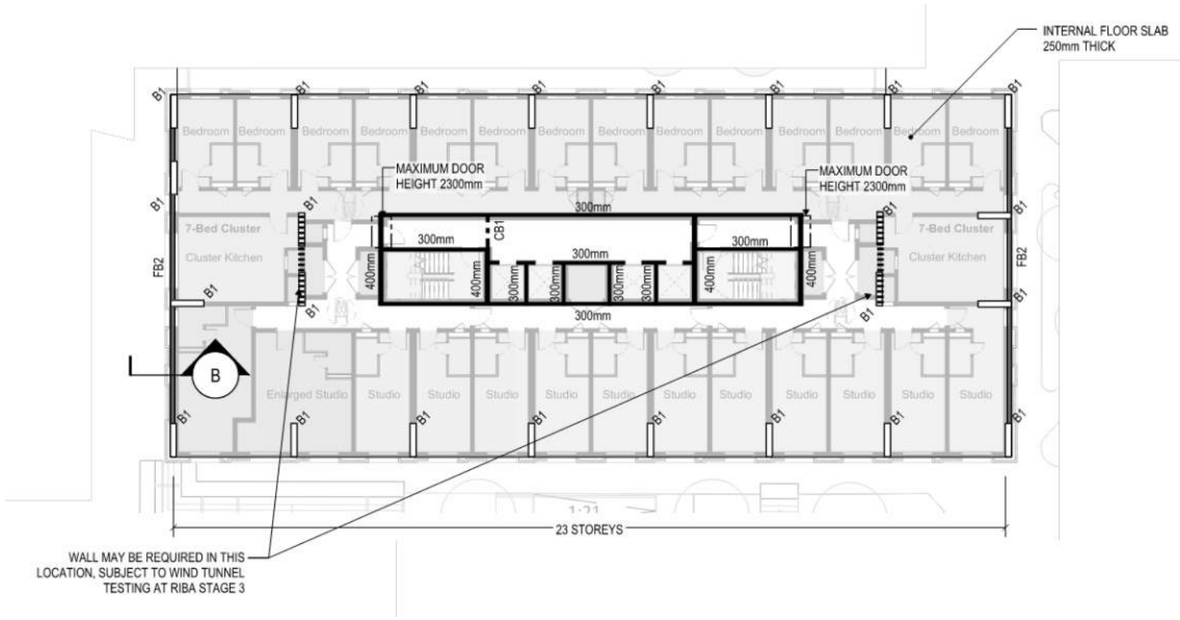


Figure 23 - 23-Storey tower floor plan

8.6 Cantilever Study

Civic engineers were requested to investigate framing options for a first-floor cantilever by Sheppard Robson. Two cantilever spans were considered throughout the cantilever optioneering as architectural layouts developed; 3m and 6.3m. Although the latest Architectural proposals do not include the first-floor cantilever, the optioneering study was included within this report should a cantilever proposal become part of the scheme development in the future.

See below a description of each framing option and a summary table of viable options for both 3m and 6.3m spans. Refer to Appendix F for the cantilever study drawings.

Cantilever Beams All levels – Cantilever beams are installed at each level and supported by two back-spans of columns.

Cantilever Core Wall – Core walls are extended to provide the mid-span cantilever supports.

Walking Columns – Columns are shifted at each level to encroach on the cantilever while remaining supported by the column below.

Strut Beams – Cantilever is supported by diagonal beams connected to columns located at ground floor.

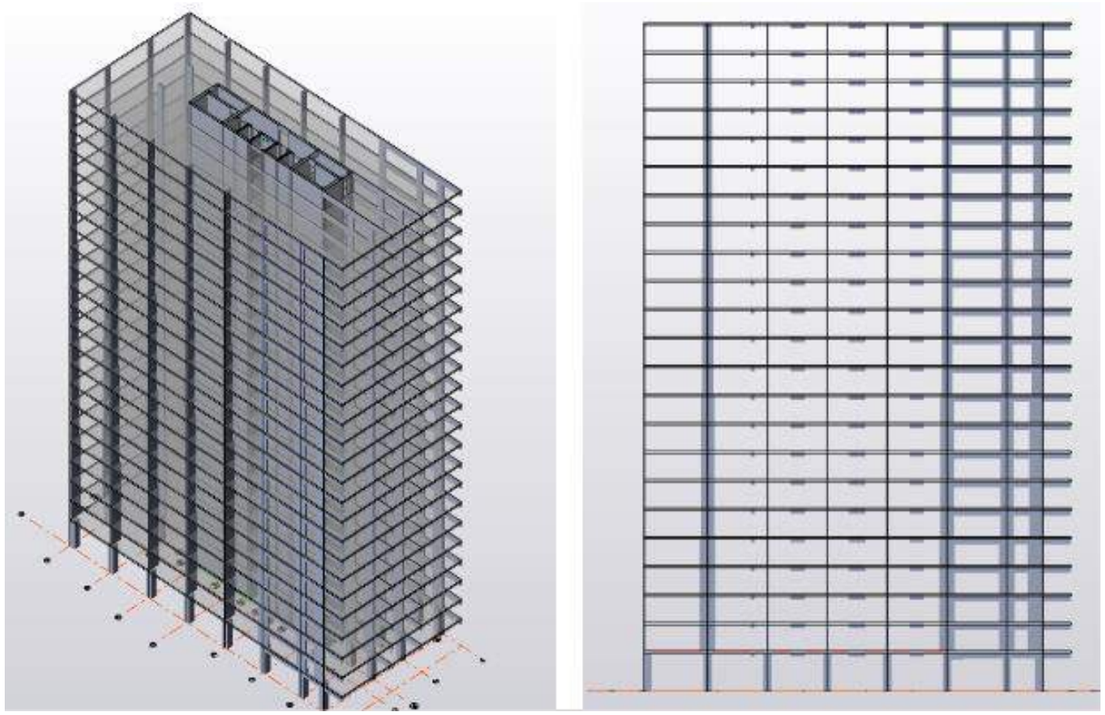


Figure 24 - Cantilever beams all levels structural model

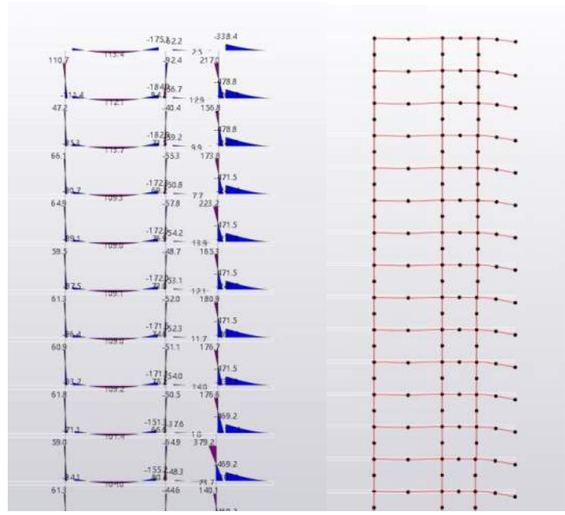


Figure 25 - (Left) Cantilever all levels elevation moment output. (Right) Deflection output (exaggerated for clarity)

Table 4 – Cantilever Study Summary Table

	Advantages	Disadvantages
3m Cantilever		
Cantilever Beams All Levels	Cantilever beams fit within walls. Floor plan flexibility.	Back-span blade column alignment to be in direction of cantilever beams. Significant amount of additional structure.
Cantilever Core Walls	Build efficiency. Fits within walls. Reduction in column quantity.	Obstructive at ground floor. Still requires cantilever beams at north and south perimeter edges of slab.
Walking Columns	Cantilever beams fit within walls. Floor plan flexibility.	Back-span blade column alignment required to be in direction of cantilever beams.
6.3m Cantilever		
Strut Beams	Efficient build, requires the least amount of structure to achieve cantilever.	Visible at ground floor.
Cantilever Core walls	As per 3m cantilever.	As per 3m cantilever.

8.7 Blade to Square column Transfer Zone at 1st Floor Level

It is an Architectural requirement for the 1650x275 blade columns to morph into a rectangular 950x750 section around the Ground Floor perimeter to achieve improve the special flexibility. As the centroids of the respective columns do not coincide, this creates a considerable bending moment of circa 1300kNm on top of the square Ground Floor column. Whist the heavily loaded Ground Floor perimeter columns pass the design checks, they require very dense reinforcement to counteract the bending moment resulting from misalignment of the blade and square column centroids as shown in Figure 26.

Therefore, it is recommended that it should be considered to move the ground floor perimeter columns slightly inboard at the next design stage (if architecturally acceptable), which would result in a much more efficient structural arrangement and likely would present savings in reinforcement quantities. This is shown in Figure 27.

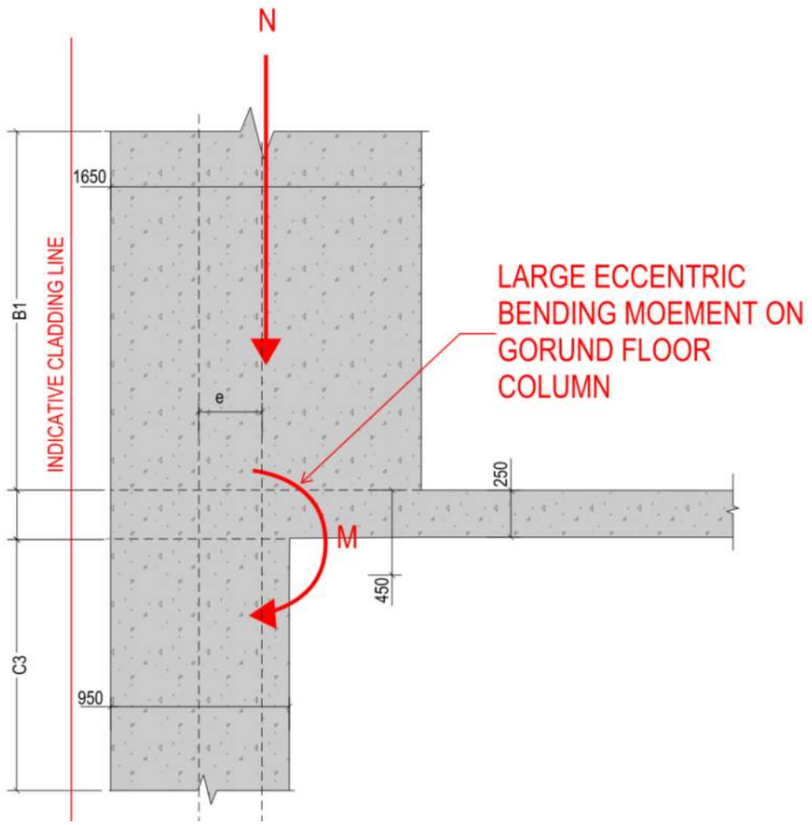


Figure 26 - Blade to Square Column Interface on 1st Floor Perimeter - Current Arrangement

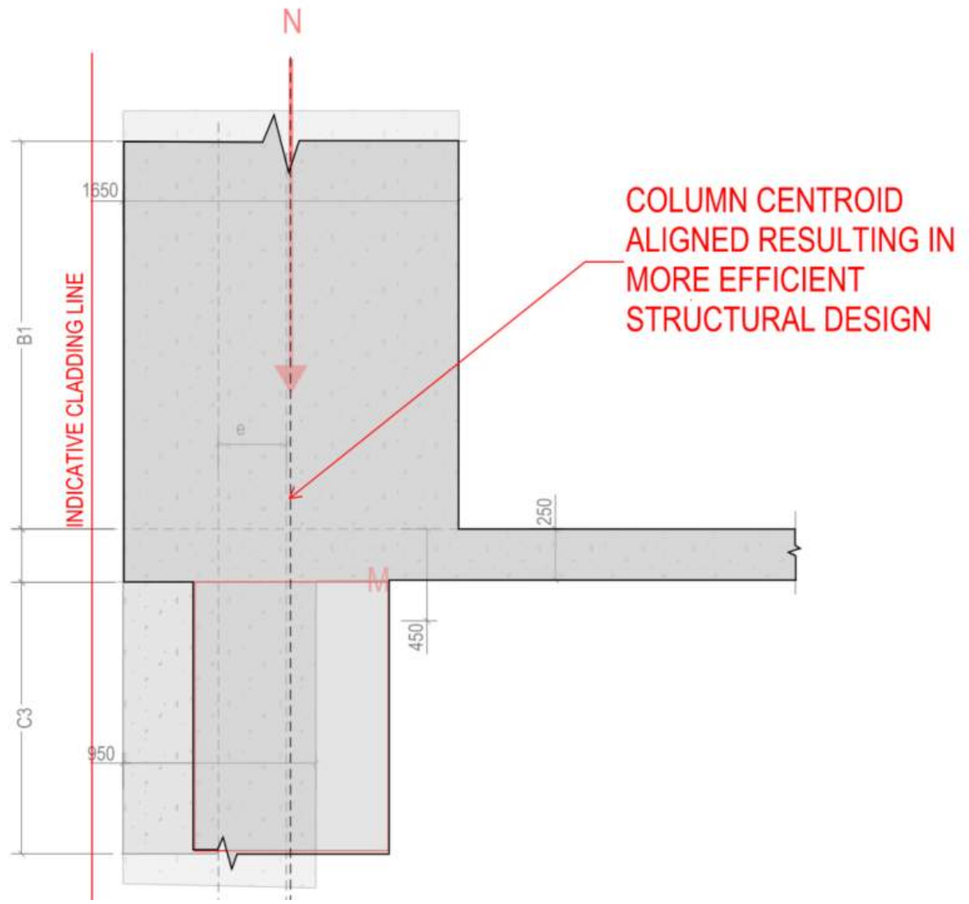


Figure 27 - Blade to Square Column Interface on 1st Floor Perimeter - Alternative Proposal

8.8 Alternative option: Precast Concrete Frame

An alternative framing option is a precast concrete frame. As RC in-situ is the preferred framing option, precast has not been developed to the same level of detail. However, as it is possible for the framing preference to change pending further design development and input from a D&B contractor, the precast scheme remains a viable alternative to RC in-situ frame

The pre-cast frame was discussed at length in the RIBA Stage 1 report. The previous iteration of the pre-cast slab design included a provision of thick podium slab at 1st floor level, between commercial/BOH space at ground floor and student pods on upper levels. This could be avoided through situating the columns directly under end of precast walls on upper floors as shown in 28 and sketch 2584-CIV-XX-XX-S-S-10008 in Appendix E. To avoid a thick first-floor transfer slab, precast walls are designed to act as simply supported deep beams and are supported by either secondary precast walls or columns. The disadvantage of this solution is an increase in column density and resultant loss of flexibility at ground floor.

Column sizes at ground floor level range between 250 x 1000mm and 450 x 1600mm for 9-Storey and 23-Storey frames respectively. Slab spans are relatively short at approx. 3m, which allows for slab thicknesses of approx. 180 – 200mm.

Structural load paths are as follows:

- Lateral loads including wind and notional horizontal loads are applied to the structure and transferred by vertically spanning facade elements into the RC flat slabs.
- RC flat slabs act as stiff diaphragms and distribute loads to precast walls and core walls.
- Precast walls and core walls transfer loads from RC slabs down to foundations.
- Vertically, precast walls act as simply supported deep beams, and are supported by secondary precast walls or columns.
- Vertical loading is transferred through precast walls into columns at ground floor and down to piled foundations.

Lateral stability is provided by RC cores and precast walls. As the precast walls are not continuous down to foundations, sliding/shear resistance is from the core walls only and foundation designs will be required to reflect this.

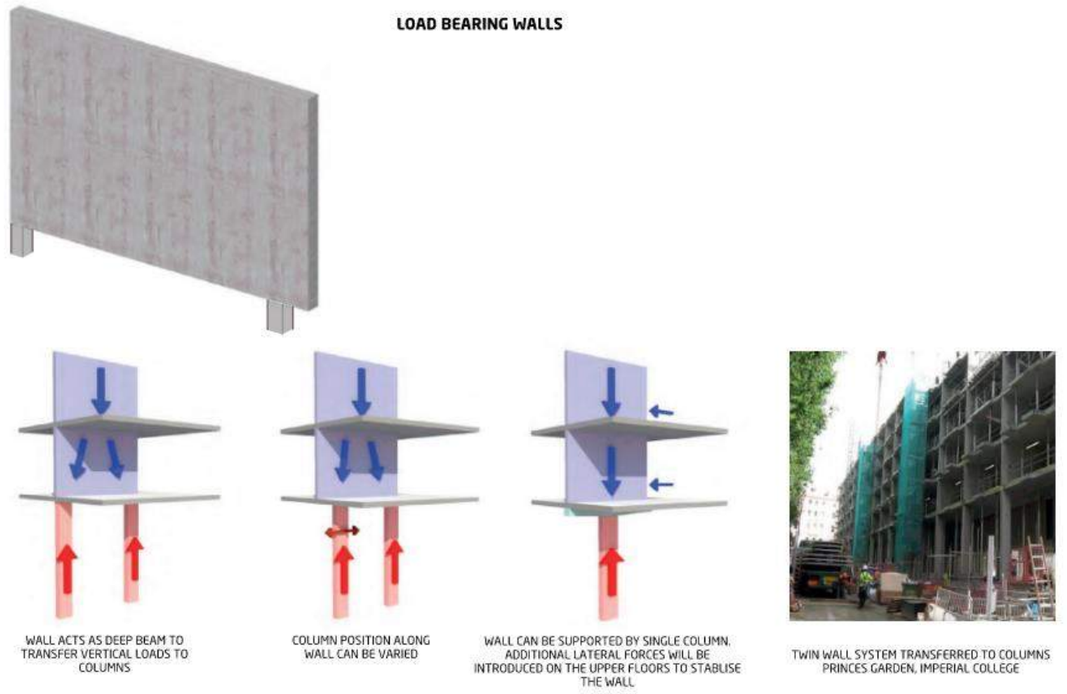


Figure 28 - Load bearing precast walls

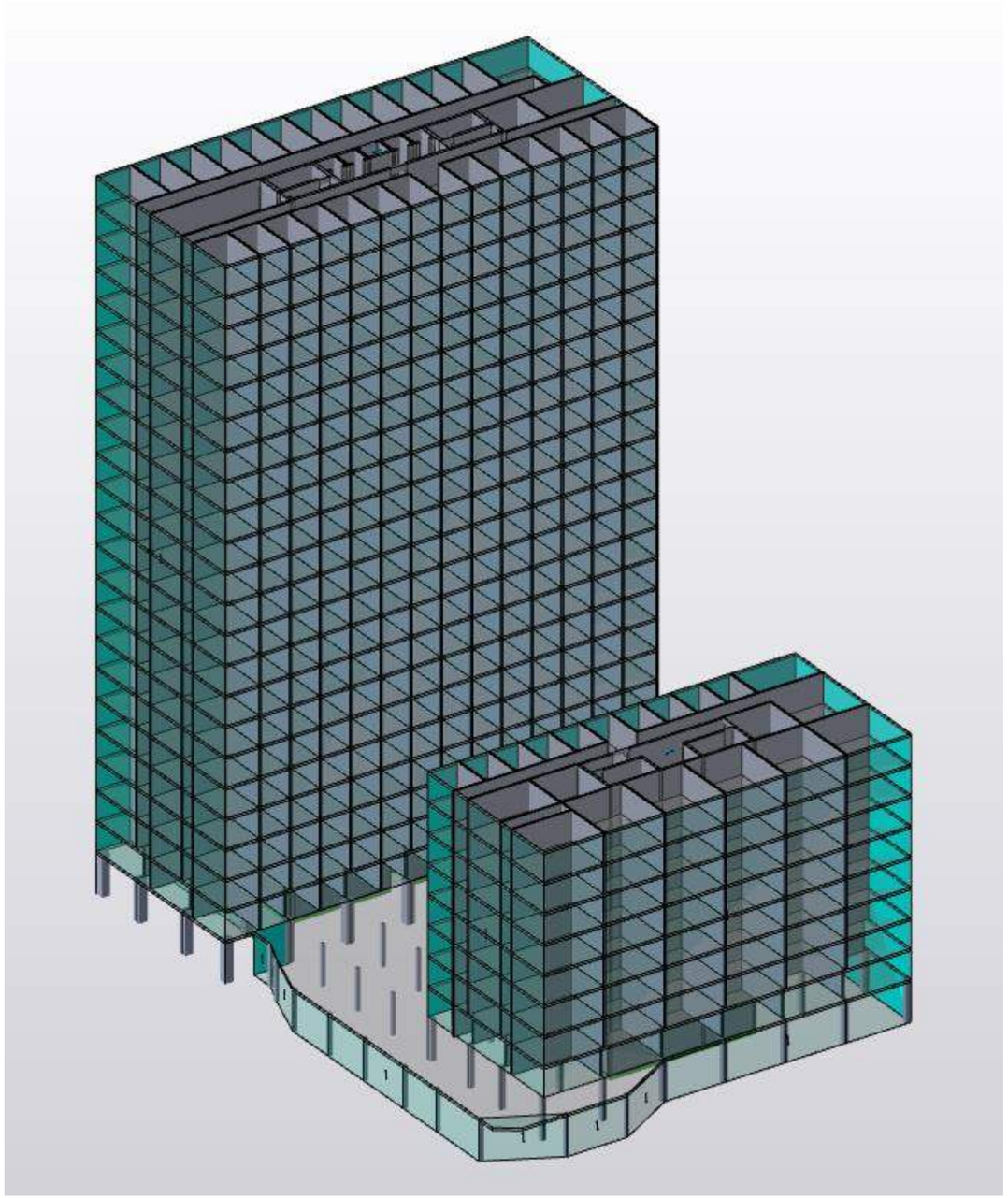


Figure 29 - Precast frame structural model

8.9 Structural Framing Options Comparison

Refer to Table 5 below for a comparison table between in-situ and precast framing options. Benefits and drawbacks of both framing options have been detailed via the following colour scheme: Green/Good, Yellow/Moderate & Red/Deficient.

Table 5 – Structural Framing Option Comparison

	Construction Speed	Site Constraints	Flexibility	Acoustics	Vibration	Fire	Sustainability	Slab Depth and Profile
In-Situ Concrete	Quick construction speed. Inherent structural robustness.	Minimal areas of laydown and storage required.	Large spans are achievable with in-situ concrete construction.	Provides inherent acoustic qualities.	Not susceptible to floor vibration.	Inherent fire protection based on strength of material and concrete cover.	Generally, less sustainable than other material counterparts. However, less concrete used in comparison to precast scheme. Opportunity to use low-carbon concrete mix,	Provides clean flat soffit for distribution of services and offering of internal finishes. In-situ concrete slabs can be post tensioned to gain greater structural efficiency.
Precast Concrete	Quick construction speed. Prefabricated elements result in rapid construction on site. No formwork required.	Precast element delivery will require a large laydown area on site.	Large spans are achievable with precast slabs, however, due to the prefabrication nature are less suitable to design changes or future change of use.	Provides inherent acoustic qualities.	Not susceptible to floor vibration.	Inherent fire protection based on strength of material and concrete cover.	Precast concrete elements are formed in a controlled factory environment resulting in higher quality control and less material wastage. Poor reuse potential may be ground to aggregate for future use.	Provides clean flat soffit for distribution of services and offering of internal finishes. Precast concrete slabs can be post tensioned to gain greater structural efficiency. Precast walls allow for closer spaced supports, allowing for thinner slabs.

9. Substructures

The Phase 1 Desktop Study by A2 have not included the substructure recommendations. However, based on the anticipated geology, loading estimates from the proposed concrete framed buildings and site constraints, Civic Engineers have made the following considerations:

9.1 Foundations Supporting 23-Storey Tower

As per section '3.4.1 Geology', historic borehole logs from the British Geological Survey (BGS) dating back to 1970 indicate that the ground profile on the site is typically made up of the following stratum:

- Made Ground (0-1.5m)
- Glacial Till (1.5-4.0m)
- Sherwood Sandstone Group: Chester Formation (4.0m - >)

9.2 Raft/Pad Foundation

Based on our understanding of geology and surrounding area and advice from the geotechnical specialists, the anticipated allowable bearing pressure of the sandstone is likely to lie in the range of ABP ~500kPa-800kPa (subject to confirmation by Phase 2 Intrusive Ground Investigation). This would suggest that apart from the piled foundations, raft and pads should also be considered.

Having carried out a high-level analysis, Civic Engineers concluded, that min. 2m deep raft foundation could potentially spread the loading from the tower above into the substrate. Whilst this solution could be structurally viable, it would require extensive temporary propping works to Upper Brook Street as shown in Figure 30 and Figure 31. Based on the Phase 1 Geotechnical Report, the formation level of the raft foundation would likely be located approximately 6m below ground level to achieve the required bearing pressure to support the 23-storey tall tower above. The made ground and glacial till above the bedrock would need to be excavated and either infilled with engineered fill or lean concrete. Alternatively, a basement could be introduced to avoid the need to large volume of infill.

If pad foundations were adopted the columns would need to extend down to the top of foundation level. This would introduce similar construction/sequencing constraints to those mentioned above with regards to the raft foundation.

Considering the extensive temporary works demand and large volume of fill required to facilitate the raft/pad foundation, it is recommended that this solution is discounted in lieu of CFA piles.

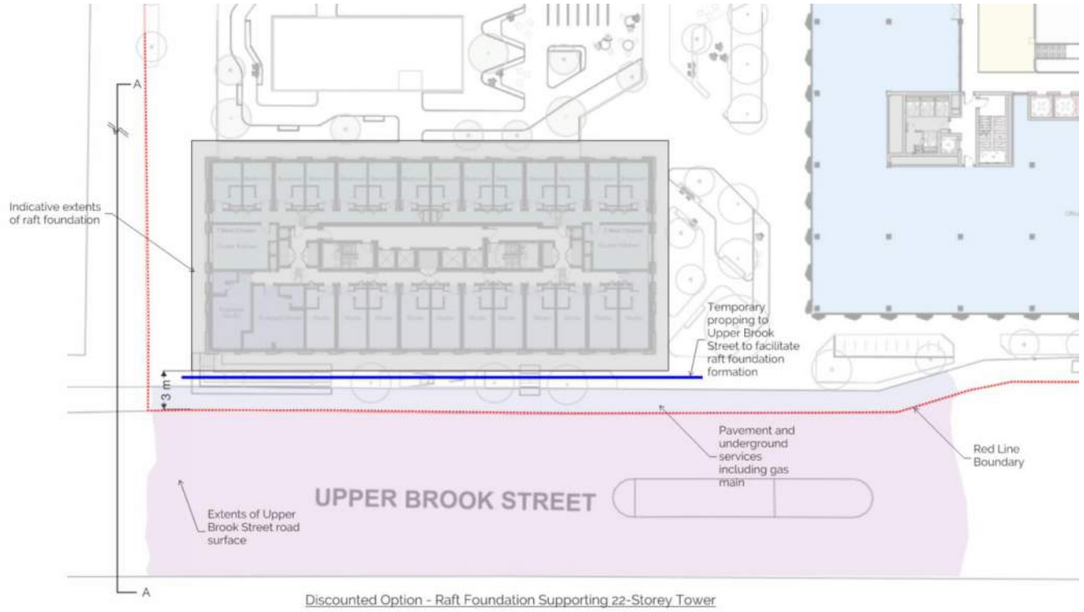


Figure 30 - Raft foundation option plan

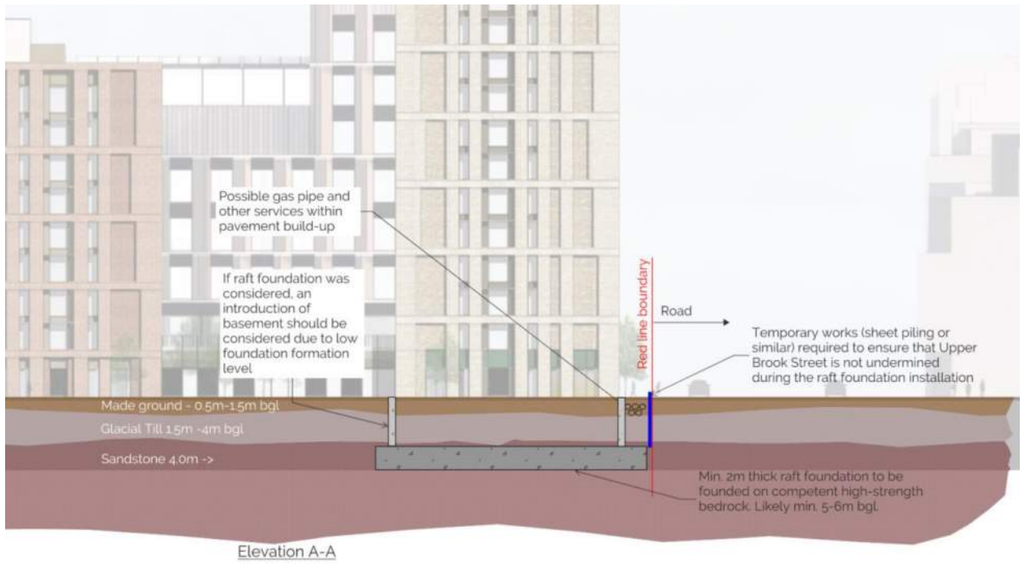


Figure 31 - Raft foundation option section

9.3 CFA Piles

It is recommended that piled foundation would be the most appropriate substructure solution for the 23-storey frame. This is due to a combination of relatively high loads from the tall concrete frame and aforementioned site constraints on Upper Brook Steet.

Based on the Phase 1 Desktop Study by A2 and our understanding of geology and surrounding area we have estimated pile number, capacity and length assuming the allowable bearing pressure (ABP) range of 500kPa to 800kPA.

This is presented in Appendix E and Figure 32 and Figure 33. The upper bound values have been used for the piling layouts.

Civic Engineers have produced preliminary layouts for 600dia and 750dia CFA piles. Based on the load magnitude resulting in a relatively congested layout of 600dia piles (a total of 190 piles), it is recommended that 750dia piles the preferred structural solution, as these are likely to provide the most cost-effective solution (a total of 124 piles). The required length of the piles will be informed by the Phase 2 Intrusive Ground Investigations. However, a high-level estimate of 16m long piles supporting the 23-storey tower can be taken at this stage.

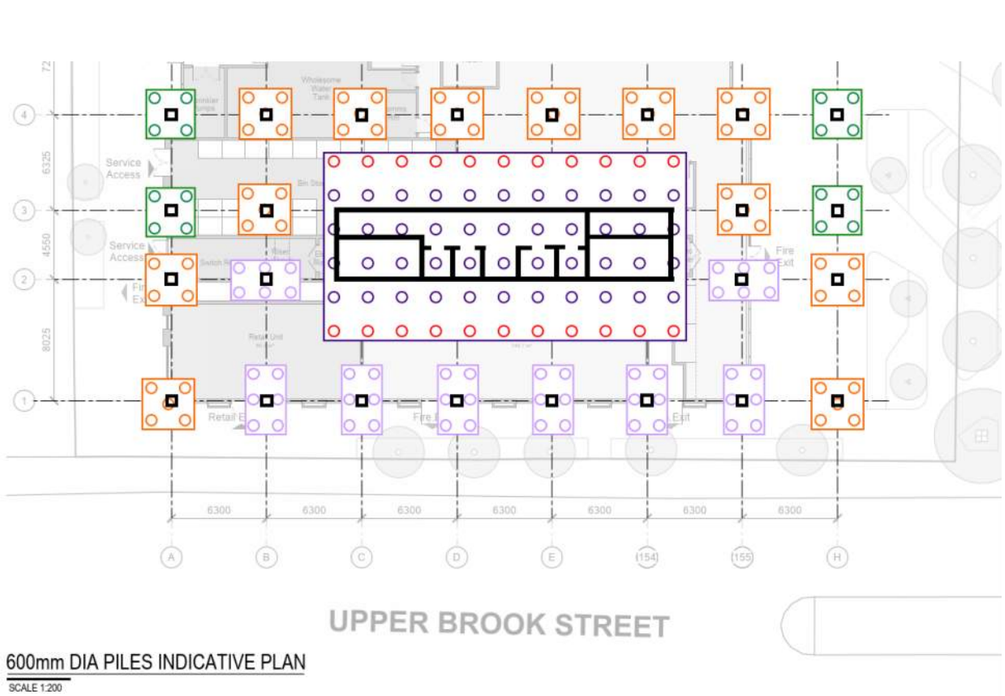


Figure 32 - 23-Storey tower 600mm dia piles indicative plan

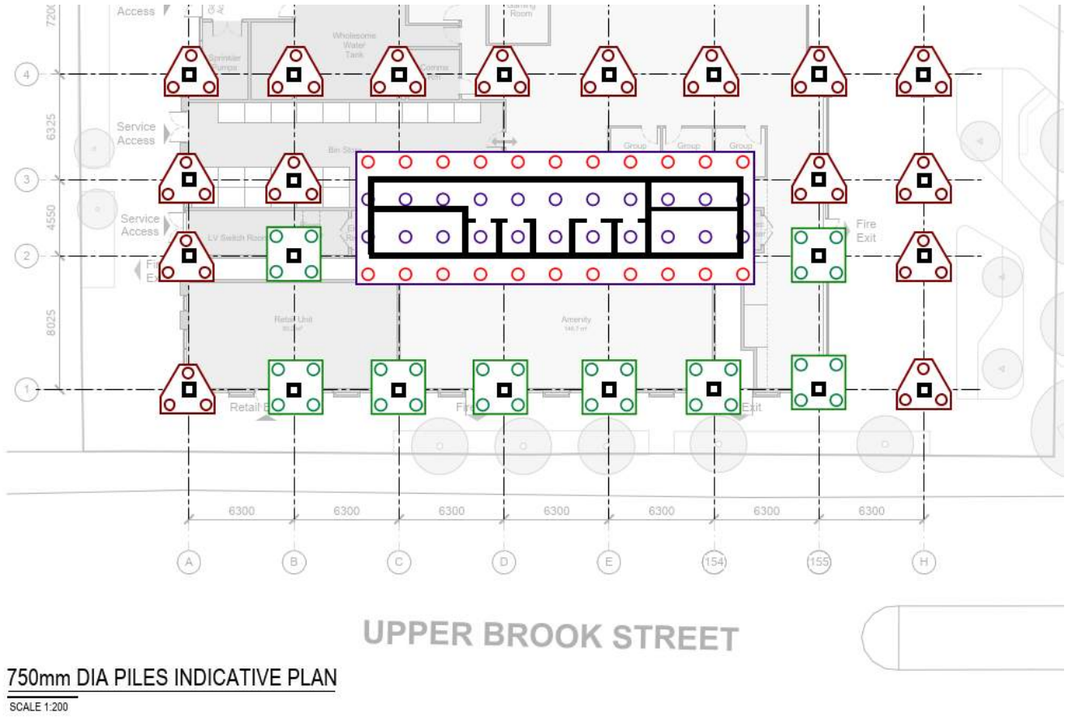


Figure 33 - 23-Storey tower 750mm dia piles indicative plan

9.4 Foundations Supporting 9-storey tower and 1-Storey Terrace

The 9-storey frame could be supported on piled or raft/pad foundations as shown in Figures 34-36. Implementation of raft/pads would be more straight forward than in the case of the taller tower. This is due to lack of constraints such as adjacent roads/pavements/buildings/services in the close vicinity of the proposed building, which would eliminate the need for temporary propping of existing structures. Whilst the risk of undermining adjacent structures would be minimal, the challenges associated with relatively low formation level of pads/raft are the same as those mentioned in section 9.2. The gap between the top of foundation and ground floor level would need to be addressed either through provision of engineered fill/lean concrete mix, extending the columns down to bedrock or introduction of a basement.

The terrace/podium structure could be supported on pads, but similarly to the towers, the columns would need to be extended down towards bedrock or large volume of engineered granular fill/lean concrete would be required to reach the bearing strata.

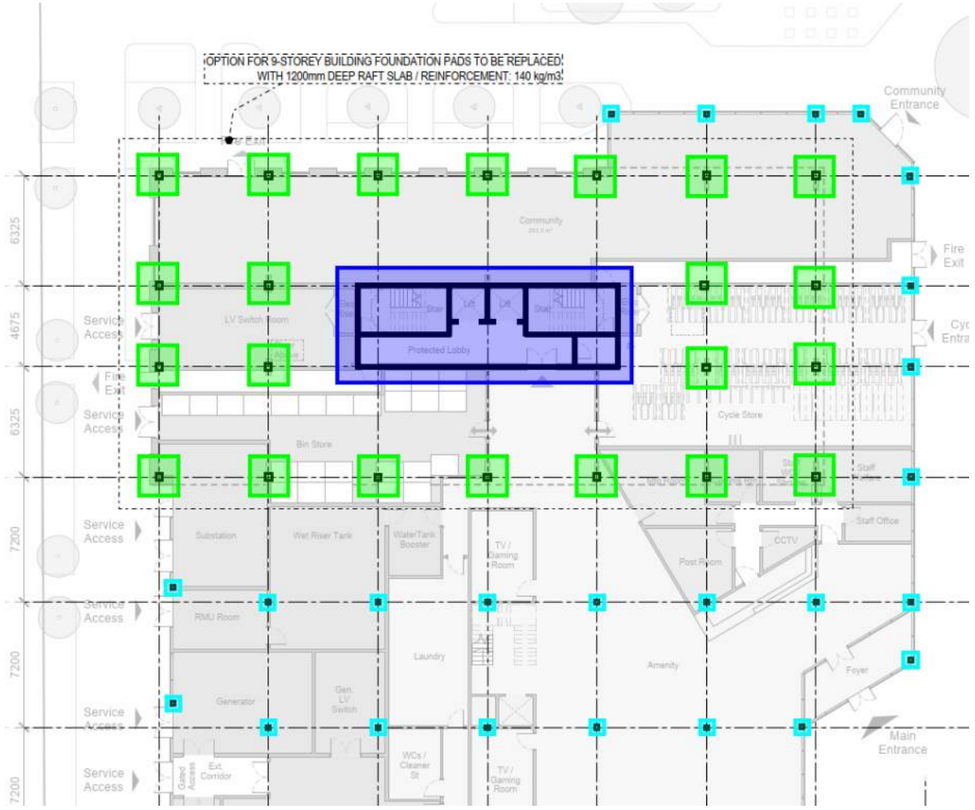


Figure 34 - 9-Storey tower indicative pad foundation plan

Considering that the recommended solution for supporting the 23-storey tower is to use piled foundation, it would likely be cost-effective to employ the same method for both the 9-storey tower and 1-storey podium. Having a singular approach to supporting all three structures would help to 'de-risk' the substructure package of works and as noted create some procurement and programme efficiencies. Civic Engineers have provided indicative piling layouts for 600dia piles (total number of 93 piles) and 750dia piles (total number of 78 piles) as per Figure 35 and Figure 36 from Appendix E. Both options appear to be equally feasible given the load magnitude and expected ground conditions. However, it could be that using a singular pile size of 750dia may provide 'economy of scale'. This will need to be confirmed with the piling contractor within the later design stages. The required length of the piles will be further informed by the Phase 2 Intrusive Ground Investigations. However, a high-level estimate of 12m long piles supporting the 9-storey tower and 8m long piles supporting the 1st floor podium can be taken at this stage as a preliminary estimate of applicable pile lengths based on our limited understanding of the site-specific ground conditions and our experience of piling on nearby sites.

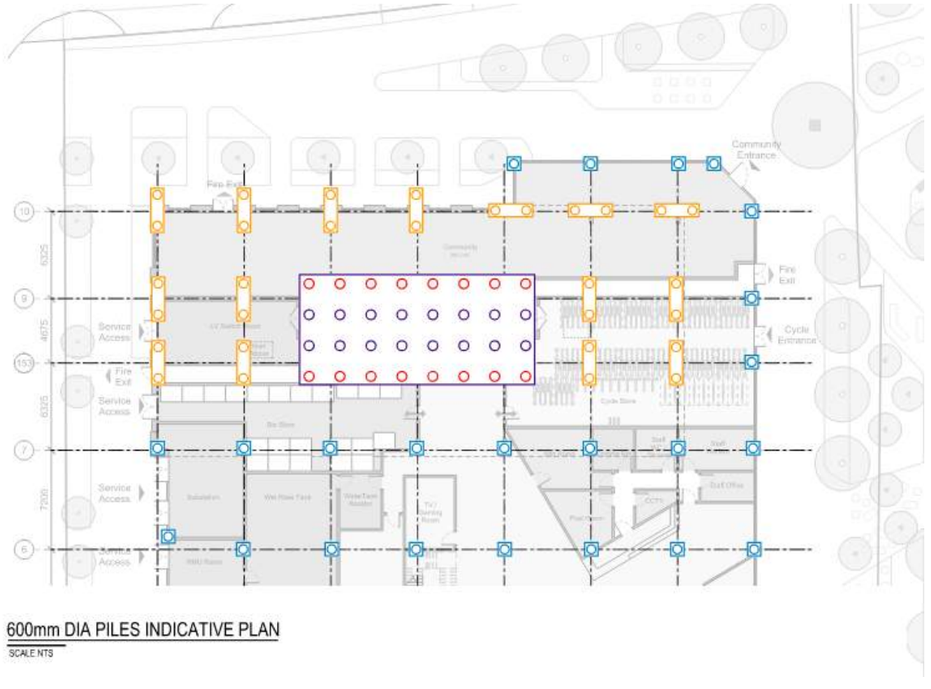


Figure 35 - 9-Storey tower indicative pile foundation plan 600mm dia piles

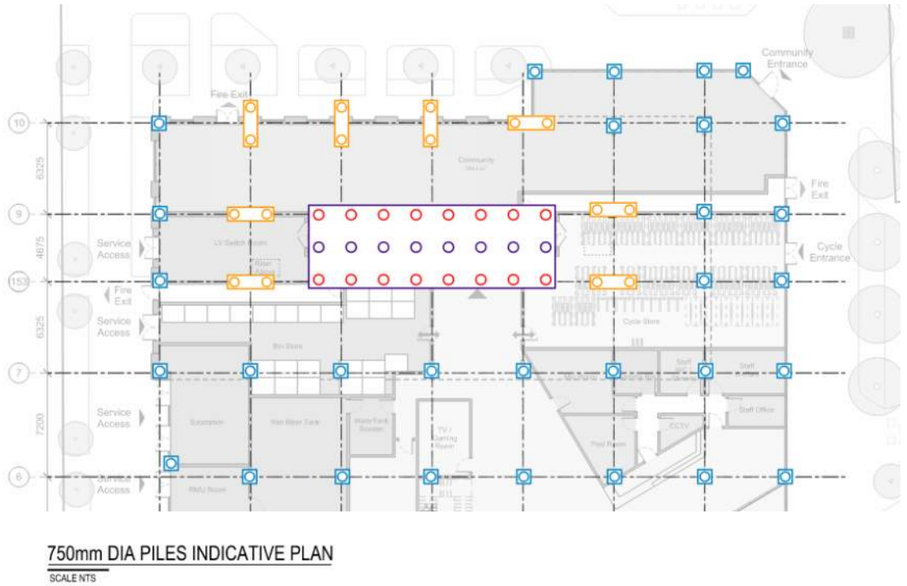


Figure 36 - 9-Storey tower indicative pile foundation plan 750mm dia piles

10. Low Carbon Concrete Analysis

10.1 Our Climate Charter

Our industry and its professional institutions have made public declarations regarding the Climate Emergency and the actions that should be taken for us to tackle it. Like so many other practices across the built environment, we have signed up to support 'Engineers Declare' and talked about the moral obligation we all must act urgently. All these declarations have inspired us to reflect on how we talk about our behaviour and approach in delivering this agenda and it is for this reason that we have put together the Civic Engineers Climate Charter.



Climate sensitivity and its protection has been a founding feature of our Practice since its inception and it is embedded in our vision, our values and our designs. We have been actively pursuing a sustainable design agenda and recognise the opportunity we have to make a real impact from in our building and urban infrastructure projects.

The five principles of the Civic Engineers Climate Charter are:

Exploring not exploiting – promoting modes of active travel and spatial planning that are rooted in nature and involve ideally located amenities and facilities that encourage healthy lifestyles.

Building not destroying – supporting mixed-use urban developments that reduce reliance on the private car and avoid unnecessary development on remote and valuable greenfield sites.

Reusing not just using – prioritising reuse and adaptions of existing building structures and infrastructure over demolition and replacement, to minimise carbon expenditure.

Listening and learning – pairing technical excellence with emotional intelligence to design buildings and environments through a truly collaborative process that is informed by the needs of people, community interests, policies, and priorities.

Creating a lasting legacy – exploration and use of upcycled materials and nature-based solutions, including the promotion of green and blue infrastructure into all designs, to encourage biodiversity and resilience against environmental extremes.

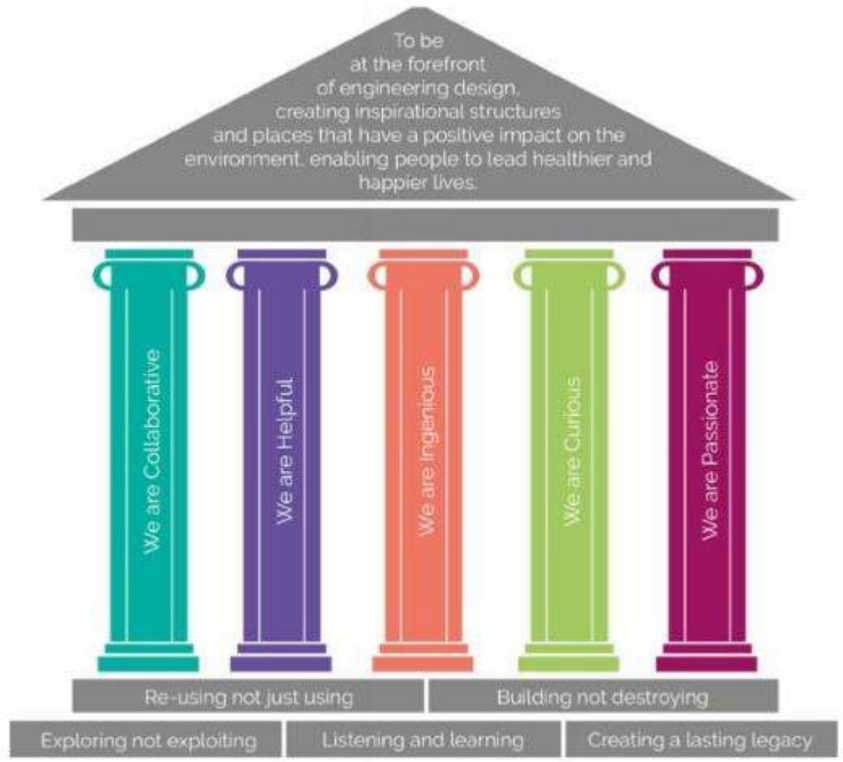


Figure 37 - Civic Engineers Principles Diagram

In an age of diminishing natural resources and extreme negative environmental impacts from the activities of mankind, the challenge for our professions is therefore greater than ever. Buildings and construction account for nearly 40% of energy-related carbon dioxide (CO_2) emissions whilst also having a significant impact on our natural habitats. The two predominant structural materials of the 20th Century - steel and concrete, generate huge quantities of greenhouse gases through their production and use but currently they continue to need to be used.

10.2 Low Carbon Concrete

Buildings are responsible for approximately 40% of global energy related carbon emissions, 11% of which are from materials and construction. As the current Upper Brook Street framing proposals are precast and in-situ concrete, there's an opportunity to utilise low carbon concrete to meet current industry carbon standards, and achieve green credentials set out by BREEAM and the circular economy framework.

The first step in creating a 'low carbon' building is within the efficiency of the design of the structural frame, reducing material first before applying CEM or other solutions.

Investigations have been conducted to determine the viability of low carbon concrete alternatives; Do the properties of low carbon concrete meet structural requirements as well as are the embodied concrete reductions justifiable for specification.

Products that have been reviewed are GGBS replacements. Typically, a hinderance with GGBS replacements is an extended curing time. However, there are products available that remove this hinderance and have been used on similar schemes, namely, Ecopact Prime AS by Aggregate Industries. This product has been used for the embodied carbon savings calculation below. Costs for the Ecopact product have been quoted to be an increase of approximately 20-25% on concrete compared to typical CEM 1 mixes.

Approximate embodied carbon savings have been calculated for the RC in-situ slabs and columns using a GGBS low carbon concrete mix that reduces embodied carbon by approx. 60%.

Table 6 – RC Elements for Low Carbon Concrete Calculation

Element	Concrete Strength	Volume
RC In-Situ Slabs	C32/40	8592 m^3
RC In-Situ Columns	C50/60	1596

The figures below are to provide guidance onto whether the time and costs associated with a low carbon frame are worth pursuing. We believe that a low carbon concrete frame fits into the narrative of the overall development and is an option that should be considered at this stage of the project.

Refer to Appendix G for embodied carbon calculation by Aggregate Industries.

The core is another area which could potentially be targeted for cement replacement, but careful discussion should be had with the tendering contractors as to methodology of core construction (i.e. slip-forming) and suitable concrete mixes which are effective for this construction.

10.2.8 RC In-Situ Slab Savings:



Figure 38 - Carbon saving calculation - RC slabs

10.2.9 RC In-Situ Column Savings

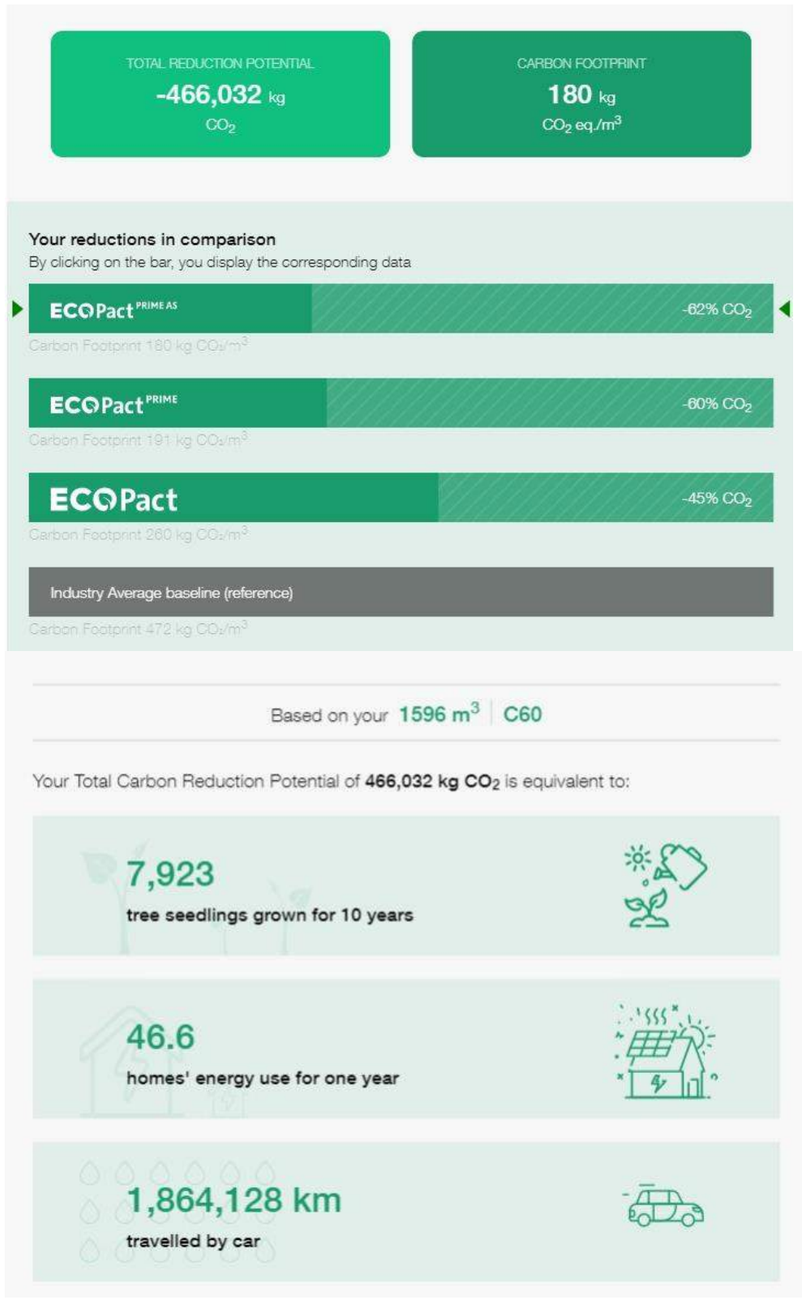


Figure 39 - Carbon savings calculation – RC columns

11. Façade Proposals

The proposed facade uses standard brick masonry, which steps in locally on plan near window openings to create a perception of depth. The near full heigh glazed window openings are further stepped in form the masonry. The anodised perforated aluminium panels surround the window openings on two sides and are positioned on the same plane as the windows. Refer to Figure 4040 and Figure 41 for details.

The proposal for the building's façade around the 1-storey podium (and partially along North facade up to 1st floor level) is to use metalwork panels and screens from the ground floor up to the first-floor terrace. This is denoted by green shading in figure 43. Fixing and support details are to be determined at later design stages.

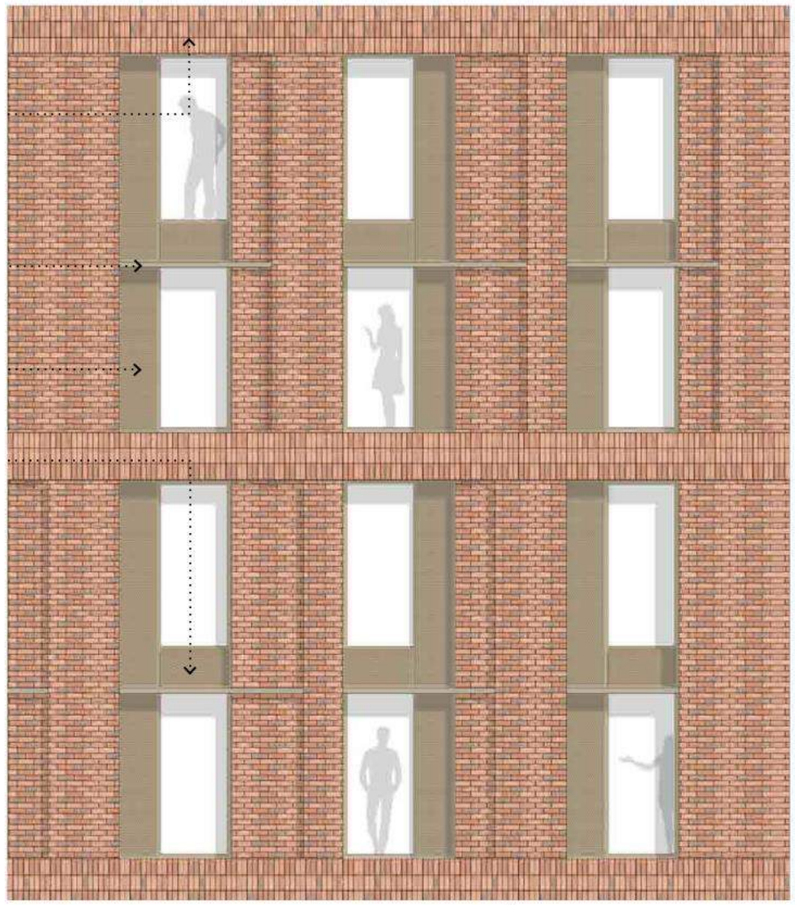


Figure 40 - Typical Elevation (Visual by Sheppard Robson)

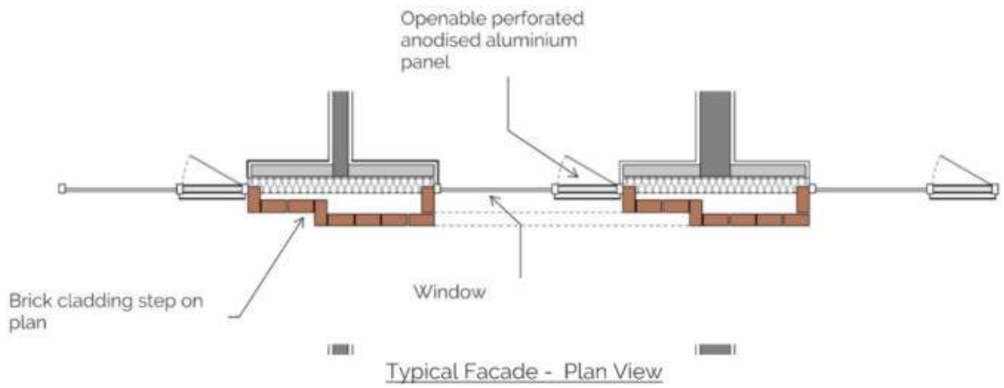


Figure 41 - Typical Architectural Facade Details

Structurally, the windows and mesh are supported at each floor and the brick masonry cladding is supported every other floor. Refer to Figure 42 for an indicative load path break down. This results in every second floor supporting approx. 6m high brick column. As the brick façade is considered a brittle element, the deflection limit for the slab edges supporting the façade was assumed at span/500, or 12.6mm for a typical 6.3m long span. To satisfy deflection criteria, slab thickenings have been proposed around the perimeter of the slab at every second floor.

Industry standard deflection limits have been applied to the design to date. Once the façade details are further developed during Stage 3 there may be a further discussion of the suitability of the deflection limits and whether any relaxation and therefore design efficiency can be granted.

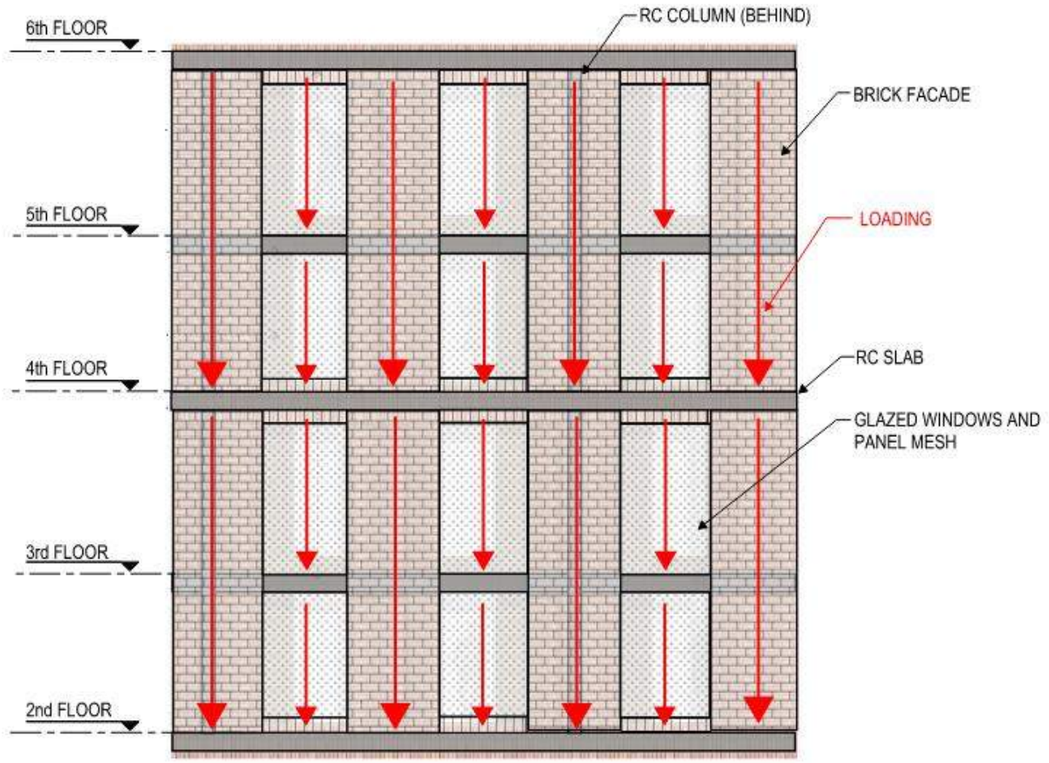


Figure 42 - Facade load take-down elevation

Current elevation proposals are shown in Figure 433. North and south elevations typically have 6.3m spans between columns, and approx. 1.6m wide concrete columns and 1.6m wide windows and panels. East and west elevations have wider spans, with the maximum being approx. 8.3m. There is also more brick cover on these elevations, resulting in increased loading.

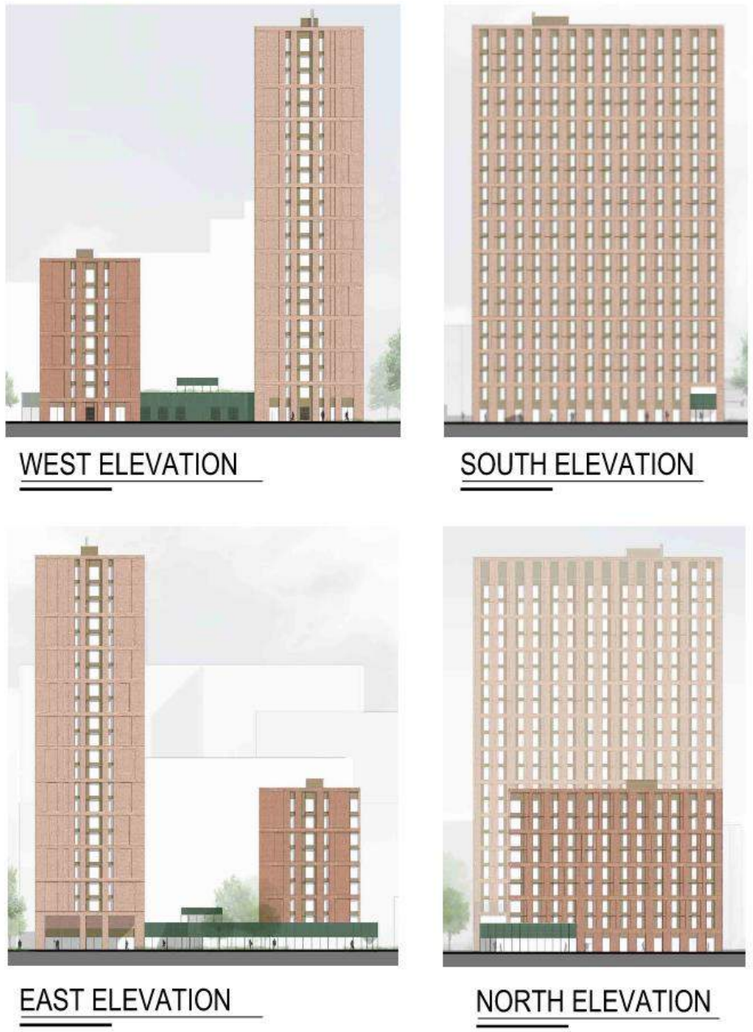


Figure 43 - Architectural facade elevations

See Figure 44 below for the slab edge down stand beams proposed detail. Following a long-term slab deflection analysis of the slabs, it was determined that only the east and west elevation typically require nominal 150mm deep downstand around the perimeter to support the proposed claddings. This is due to the North and South elevations being relatively heavy in comparison to the East and West elevation, which house considerably mode window openings. The east and west elevations also house larger spans between the columns reaching 8.3m which is considerably greater than a typical 6.3m span on adjacent elevations. Above the SSL, there is a 30mm upstand for a façade fixing as specified by the architect.

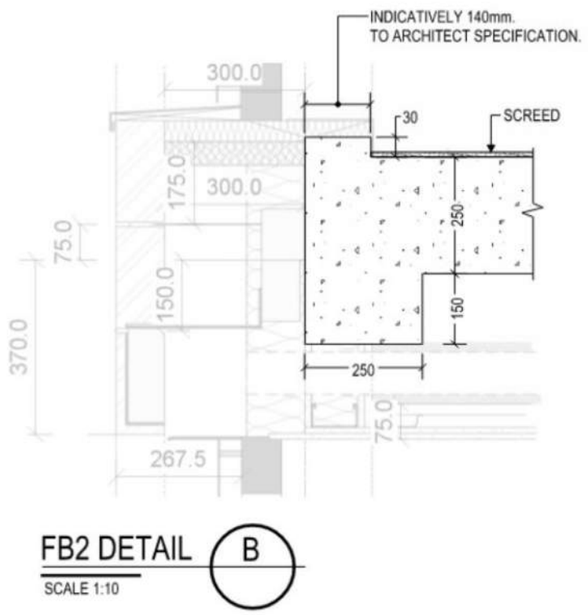


Figure 44 - Slab edge beam detail supporting cladding on every other floor on North and South elevations

- The Initial Notification of Project (F10) was logged with the HSE on date required.
- Copy of the Initial F10 attached.
- Copy of HSE e-mail acknowledgement attached.
- Copy of current F10 to be displayed on site at all times.

12.Design Criteria

The following outlines the minimum design values and standards that are to be used in the development of the structural design.

12.1 Principal Design Codes

The structural engineering design is generally to be based on the Eurocodes and associated UK National Annexes. UK industry recognised guidance documents are also proposed to be used.

12.2 Design Working Life

Design working life shall be 50 years i.e. Category 4, for building structures and other common structures in accordance with BS EN 1990 table 2.1

12.3 Permanent Actions (Dead Loading)

The self-weight of concrete frame forming the development have been outlined in Table 5. These are calculated in accordance with BS EN 1991-1-1 Annex A (tables for nominal density of construction materials) or using manufacturer/product supplier specified loads.

Table 7 – Material Densities

Materials	Density γ (kN/m³)
Normal weight reinforced concrete	25
Steel	78
Clay brickwork	25
Glass	25

Elements of the building fit out are not fully developed at this stage therefore the assumptions highlighted in Table 8 have been used. These elements relate to the superimposed dead loading applied to the structure as part of the Architectural and M&E fit out. These values have been taken from The Structural Engineer Technical Guidance Note (Note 2, Level 1) but are general allowances and are subject to change following confirmation on the proposed finishes and building services.

Table 8 – Superimposed Dead Loads

Superimposed Dead Loads	Area Load g_k (kN/m²)
Finishes	0.85
Services + ceiling	0.25
Façade (assumed from materials and composition in details)	Windows and panels (every floor): 5.65 kN/m Brickwork (2 floors height, supported every second floor): 13 kN/m Refer to Section 11 for façade elevations

12.4 Minimum Variable Actions (Imposed Loading)

Variable actions are dependent on the proposed floor use. Allowances are outlined in Table 9 and are in accordance with BS EN 1991-1-1.

Table 9 – Imposed Loads

Type of Activity/Occupancy	Category	Area load q_k (kN/m²)	Concentrated load Q_k (kN)
Domestic and residential areas	A1	1.5	2.0
Corridors and Hallways	C32	3.0	4.5
Entrance, stairs/ramp	C35	4.0	4.0
Commercial space	D1	4.0	3.6
Roof	H	0.6	0.9
Plant room	E213	7.5	4.5
Partitions	A1	1.0	Varies

12.5 Lateral Actions (Loading)

Wind actions for the overall building stability and for cladding design shall be in accordance with BS EN 1991-1-4:2005. At this stage conservative peak wind velocity pressure have been derived using the above Codes of Practice and have been used in the early concept design of the stability members. Wind tunnel testing has been commissioned to develop detailed understanding of structural wind loading on both the superstructure and cladding elements. This will enable Civic Engineers to develop their design.

12.6 Accidental Loading

Accidental loading will be considered on appropriate elements during the design stage and will include vehicle and aircraft strikes. Affected structural elements shall be designed in accordance with Eurocode 1-1-7-2006.

12.7 Deflection Limits

Serviceability limit states in buildings should consider criteria related to floor stiffness, storey sway and/or building sway. Here, stiffness is expressed in terms of limits for vertical deflections and sway is expressed in terms of limits for horizontal displacements outlined in Table 10 and Table 11.

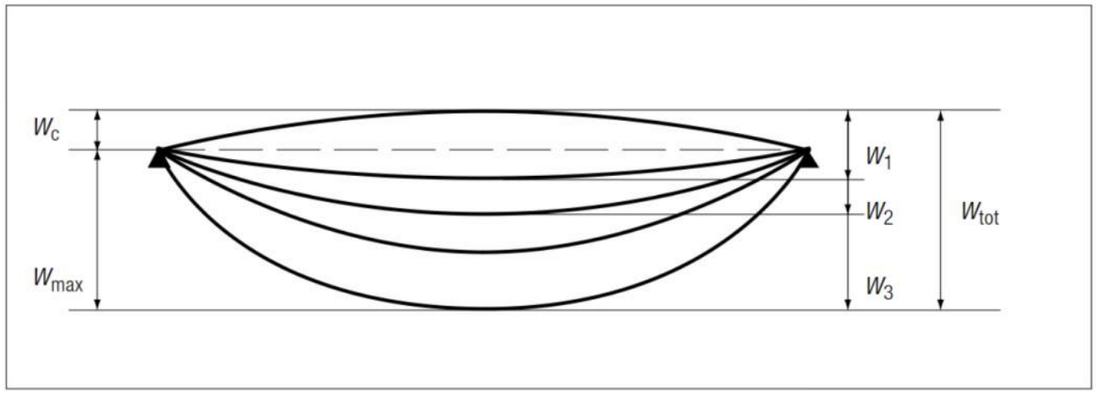


Figure 45 - Deflection calculation diagram

Key:

W_c Precamber in the unloaded structural member

W_1 Initial part of the deflection under permanent loads of the relevant combination of actions

W_2 Long-term part of the deflection under permanent loads

W_3 Additional part of the deflection due to the variable actions of the relevant combination of actions

W_{tot} Total deflection as sum of w1, w2, w3

W_{max} Total deflection other than that due to precamber (i.e. wtot – wc).

With regards to vertical deflection, this will be reviewed in relation to instantaneous dead load (item w1 above) and superimposed dead load and imposed load under long term loading conditions and creep.

Table 10 – Vertical Deflection Limits

Vertical Deflection Limits	Limiting Criteria
Total deflection	Span/250
Live load deflection	Span/360
Deflection of brittle elements (+ façade)	Span/500
Deflection of flat roof	Span/250
Cantilever	Span/180

Table 11 – Horizontal Deflection Limits

Horizontal Deflection Limits	Limiting Criteria
Sway of each storey in a multi storey column	Height/300
Sway of column with movement sensitive cladding	Height/500

13.Civil and Structural Further Investigation Works Required

Following Stage 2, the following survey/investigation works are still to be developed leading into Stage 3:

Table 12 – Civil and Structural Further Works

Investigation Required	Scope of Investigation	Responsibility
Phase 2 Ground Investigation	To verify ground conditions and geology to inform substructure proposals. To verify contamination and gas risk (if present) to inform remediation proposals.	A2 Soil Investigations
Drainage Strategy	Development of the drainage strategy and coordination with existing below ground services.	Civic Engineers
Transport	Development of the site and surrounding area transport strategy.	Civic Engineers
Wind Tunnel Study	Wind tunnel testing for 23-Storey tower to accurately determine anticipated structural wind loading on towers to enable development of structural proposals.	Wind Tunnel Specialist
Plinth and Upstand	Requirements for plinths and upstands. Specifications on dimensions, material, composition and locations.	Civic Engineers Sheppard Robson
Slab Requirements	Coordination of slab levels, setting out, build-up, finishes and requirements for falls.	Civic Engineers Sheppard Robson
Lift Specification	Lift manufacturer specifications for setting out, allowable loading and lift pits.	Lift Manufacturer
MEP Coordination	Coordination of riser penetrations and core walls.	Cundall
Façade Design	Façade connection details.	Façade Specialist
Design Responsibility Matrix	Confirmation of contractor design items and development of design responsibility matrix.	Design Team Contractor
Additional GPR surveys	If surface water connection to the Cornbrook Culvert is required, then a GPR survey of the Upper Brook Street (UBS) will be required for the stretch from the site up to the culvert to ascertain if connection through UBS is viable.	Civic can procure – but will need instruction from the client to do so.
Additional CCTV survey	If surface water connection to the Cornbrook Culvert is required, then a CCTV drainage survey of the culvert will be required. Location of the Culvert to be determined.	Civic can procure – but will need instruction from the client to do so

14.Civic and Strucutral Project Risks Register

Various project risks have been identified through the stage design. The quantity surveyor should make due allowance for the risks identified below. These risks will be explored further at the next stage of the design process. Refer to below summary table

KEY

Residual Risk:

High Medium Low

Table 13 – Project Risks Summary

Item	Risk	Description	Mitigation Measures
1	Unidentified Utilities	The sewer location withing the site boundary, which was a major RIBA Stage 2 risk, has now been confirmed. However, some of the GPR survey results (carried out by Layer) do not match the Cornerstone desktop study. Cornerstone identified numerous buried services under the pavement on Upper Brook Street including telecom, water and notably a gas main. None of these services were confirmed by Layer. This could be due to survey or map inaccuracies.	Further GPR survey is recommended to take place along Upper Brook Street pavement. Opening up works may be required.
2	Clashes with existing foundations	The existing steel framed building is likely to be founded on pad footing due to its low height. Other buried obstruction may be present throughout the site.	Existing foundations and any ground obstructions to be grubbed out to a depth of 2m below underside of existing slab. Civic Engineers to include this requirement in the Earthworks specification at RIBA Stage 3.
3	Cellular towers	Two large cellular towers located to the front of the Kadans site on Upper Brook Street may require relocating based on their height and proximity to the site.	Allow provisional sum for the cellular tower relocation.

4	Surface Water Drainage	Due to the location and conditions of site, infiltration may not possible (subject to Phase 2 GI results). It may also not be possible to discharge into a nearby water body or surface water sewer. UU have made Civic aware that there is the Cornbrook culvert approximately 140m from the site. the location of this culvert is to be determined. A PDE has been issued to the LLFA to commence consultations in relation connection to the culvert – response pending.	It is recommended that surface water be discharged into the existing UU combined network located on Upper Brook Street. Civic Engineers has submitted a pre-development enquiry and dialogue with the UU is ongoing. UU has advised that they will accept 26ls into their network, IF the LLFA will not accept discharge into the culvert. In following the SuDS hierarchy, the LLFA may not accept connection to the UU network until all other options have been explored and disproven – ie connection to the culvert. A PDE has been issued to the LLFA to commence consultation in relation to their preferred points of connection/ allowable discharge rates – response is pending at time of issue. We recommend that dialogue should be kept open to explore all options and limit risk with regards to surface water discharge. For further details, refer to the 'Drainage Strategy' section of this report.
5	Poor Ground Conditions	Detailed ground investigations within the footprint of the building will be required to: -Confirm contamination of the ground on site and presence of ground water - Confirm the depth/characteristics/quality of the underlying soil/rock strata inform the most suitable foundation solution	The findings from Phase 1 GI desktop study are in line with the expectation of local geology. Civic Engineers have prepared site-wide (including Kadans site) scope of works for Phase 2 Ground Investigation works. It is recommended that these works are undertaken asap so that the results can inform RIBA Stage 3 design.
6	CFA piles unfeasible	Stiff rock and ground obstructions could prevent an effective use of CFA piles. IF CFA piles encounter particularly stiff layer of rock or obstructions such as existing concrete pads, their location may need to be changed to avoid the localised hard spot. If the obstruction density is high, CFA piles may prove unfeasible altogether.	Ground investigation to be undertaken to establish the strength and characteristics of underlying soil and rock. Existing obstruction to be removed to 2m below existing basement slab level as per Civic Engineers Demolition Specification. Rotary bored piles may be used instead of CFA piles to mitigate the risk of hitting obstructions. This would come at a significant cost uplift.
8	Damage to Upper Brook Street paving and/or existing services	Damage to Upper Brook Street paving and/or existing services during demolition/construction works.	Civic Engineers proposed piling to be undertaken in lieu of raft foundation for the 23-storey tower to reduce the risk of undermining the Upper Brook Street pavement and road surface. Demolition and main contractor to submit RAMS for Civic Engineers review prior to works commencing
9	Existing building's substructure may vary from assumed conditions	Existing building's ground floor build-up is assumed to be of ground bearing or suspended slab construction. It is unlikely but possible that deep trenches are present withing the building's footprint. If any trenches/basements are present, this may not be covered with the 2m deep allowance for grubbing out.	Access to existing building to be provided for Civic Engineer's inspection at the earliest convenience to confirm whether trenches/basements are present with thing the building's footprint.

15. Stakeholder Engagement

There is a number of stakeholders involved in the Upper Brook Street development and transparent communication is required to ensure the schemes' swift delivery. The key next step stakeholders are:

United Utilities (UU)

Liaison with UU has commenced, A PDE has been issued, it was in response to this PDE that UU highlighted the Cornbrook culvert located approximately 140m from site. they have advised that consultation with the LLFA should commence, as in accordance with eh SuDS hierarchy, the culvert could be a possible preferred point of connection. A workshop was held with UU. They have agreed that if the LLFA won't accept surface water discharge to the culvert, UU will accept connection to the existing network at 26l/s. It has been proposed to discharge foul water from the site into the UU's existing network.

Any connection to the public sewer network will be subject to a formal agreement with the sewerage provider under Section 106 of the Water Industry Act 1991.

Lead Local Flood Authority (LLFA) & Local Planning Authority (LPA)

The principles of the proposed surface water drainage strategy have been shared with the LPA & LLFA and responses are pending at time of issue. As the design progresses, consultation with the LLFA will continue to ensure their buy-in throughout.

16. Appendices

Appendix A – A2 Phase 1 Site Investigation Report

Appendix B – Cornerstone Utilities Survey Report

Appendix C – CCTV Survey Report and Drawing

Appendix D – Drainage Strategy Options Drawings

Appendix E – Structural Framing Options Drawings

Appendix F – Cantilever Study Sketchbook

Appendix G – Low Carbon Concrete Savings Calculation

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Landmark Information

alpha ASSOCIATES



Upper Brook Street

Landmark Order No: 344685601_1

Client Reference: 7293

Detailed Unexploded Ordnance (UXO) Threat and Risk Assessment with Risk Mitigation Strategy

Meeting the requirements of the United Kingdom's Construction Industry Research and Information Association's Unexploded Ordnance Risk Management Framework: "Unexploded Ordnance (UXO) – A Guide for the Construction Industry" (C681) and in compliance with the Construction (Design and Management) Regulations 2015

Landmark Information Group in partnership with 6 Alpha Associates Ltd

Project No.: 11217

8th May 2024

V1.0

Using This Report

This Detailed UXO Threat and Risk Assessment with Risk Mitigation Strategy is designed to inform the reader whether military related Unexploded Ordnance (UXO) is likely to pose a hazard at the Study Site and if so, calculate the level of risk generated by proposed or likely ground intrusive operations at the Site. The assessment is intended to meet with the requirement of Stages 2 and 3 of the *Health and Safety Executive* endorsed *CIRIA C681 UXO Risk Management Framework* – for which *6 Alpha* were the lead technical author.

There are two prospective outcomes of this report; either the risk level requires a Risk Mitigation Strategy (Stage 3 of the *CIRIA C681* framework) aimed at reducing UXO risks As Low As Reasonably Practicable (ALARP) in accordance with the Project's minimum legal responsibility; or that no further action is required. In the former instance *6 Alpha* will provide a Risk Mitigation Strategy consisting of proactive and/or reactive risk mitigation measures aimed at reducing the identified risks to ALARP.

Document Control

Version	Author(s)	Reviewed By	Recipient
1.0	Beth Skoulding	Laurence Gregory	Client Reference: 7293

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Executive Summary

Document Scope

6 Alpha Associates Limited (6 Alpha) has been commissioned in partnership with the *Landmark Information Group* to provide a UXO Threat and Risk Assessment with Risk Mitigation Strategy, for the Site described as "Site at 384813, 396894". The Study Site is centred on *British National Grid Reference* 384812, 396894.

UXO Threat Assessment Summary

The output of *6 Alpha*'s UXO Threat Assessment is summarised at Table I:

UXO Threat Assessment Summary			
Threat Source		**Result**	**Comments**
	Was the Site or its vicinity considered a primary bombing target during WWII?	✔	*Luftwaffe* aerial photography identified the *Victoria University* (located 305m to the south-west) as a primary bombing target.
	Was the Site or its vicinity bombed during WWII?	✔	*ARP* records identified 55 HE bomb strikes within a 1,000m radius, one of which was documented on-site.
	Was the Site or its vicinity damaged by bombing during WWII?	✔	Residential structures in the north of the Site were destroyed by bombing during WWII, with additional bomb damage likely recorded as close as 35m to the south-east of the Study Site boundary.
	Has any *British* military activity been identified in the area?	✘	Although the *Ardwick Green Barracks* (located approximately 425m to the north-east) served as the *Headquarters* of the *8th (Ardwick) Battalion of the Manchester Regiment* during WWII.
	Has ordnance been manufactured and/or stored at the Site or its vicinity?	✘	None recorded within 1,000m.
	Does UXO contamination pose a potential hazard at the Study Site?	✔	Given the bombing and bomb damage was recorded on-site, it is considered possible that UXO might be encountered.

Table I: UXO Threat Assessment Summary

UXO Threat Items

Given the evidence presented at Table I, *6 Alpha* consider it reasonably foreseeable that a UXO encounter could occur at this Site. The most probable UXO threat items are *German* HE bombs and IBs. *British* AAA projectiles may also pose a residual threat.

Potential UXO Burial Depth

Given the likely ground conditions at the Study Site, the average WWII bomb penetration depth has been calculated as 5m below WWII ground level at this Study Site. Although larger UXBs could be present below this depth (potentially up to 10m), they were deployed infrequently during WWII and are highly unlikely to be encountered.

UXO Risk Pathways

The Study Site has undergone notable post-WWII developments, with bomb-damaged structures cleared across the Site by 1946. The remainder of the pre-existing structures were cleared from the Site by 1992. At that time, the existing structure appears to have been built across much of the Site, along with areas of hardstanding. Consequently, it is considered likely that any UXO contamination within ground that has been disturbed since WWII would likely have been discovered and removed.

Nonetheless, given the depths of the proposed intrusive works below ground level, a potential UXO risk pathway could be generated by intrusive works within any remaining area(s) of ground that has not been disturbed **since the time it might have been contaminated with UXO**.

UXO Risk Assessment

A Semi-Quantitative UXO Risk Assessment has been undertaken and the UXO risk rating is assessed to be:

HIGH

Such risks may pose harm to human health and damage any equipment involved in intrusive activities; the former is intolerable. Therefore, such risks will require mitigating in accordance with the ALARP principle, through the implementation of a risk mitigation strategy (see below, and Part III of the report).

Risk Mitigation Strategy

6 Alpha recommends that the UXO risk to the proposed intrusive works is reduced ALARP, through the implementation of both proactive and reactive UXO risk mitigation measures.

Recommended UXO Risk Mitigation Measures

There following risk mitigation measures summarised at Table II, are recommended as a minimum in order to reduce risks ALARP during intrusive works in **all previously undisturbed ground**.

UXO Risk Mitigation Measures Overview							
Proposed Intrusive Works		Emergency Response Plan	Safety and Awareness Briefings	On-Call EOD Engineer	UXO Watching Brief	Non-Intrusive UXO Survey	Intrusive UXO Survey
Open Works	Trial Pits	✔	✔	✘	✔	✘	✘
	Excavations	✔	✔	✘	✔	✘	✘
Blind Work	Boreholes	✔	✔	✘	✘	✘	✔
Residual UXO Risk Rating		ALARP					

Table II: UXO Risk Mitigation Measures Overview

Recommended Next Steps

We recommend that the Client's next steps are focused upon phase four of the UXO Risk Management Framework namely, the detailed designs of the recommended UXO risk mitigation measures as outlined above. The design ought to be finalised and the UXO risk mitigation measures are to be executed in advance of the GI and/or construction phases of work, in order to warrant and to evidence that UXO risks can be mitigated and reduced to ALARP.

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Appendix 2 – Site Boundary

Appendix 3 – Modern Aerial Photography

Appendix 4 – WWII High Explosive Bomb Density

Appendix 5 – WWII Luftwaffe Bombing Targets

Appendix 6 – WWII Bomb Strikes

Acronyms and Abbreviations

AAA	Anti-Aircraft Artillery	**NEQ**	Net Explosive Quantity
ALARP	As Low As Reasonably Practicable	**NGR**	National Grid Reference
ARP	Air Raid Precaution	**OS**	Ordnance Survey
AXO	Abandoned Explosive Ordnance	**PoW**	Prisoner of War
BDO	Bomb Disposal Officer	**RAF**	Royal Air Force
bgl	Below Ground Level	**RMS**	Risk Mitigation Strategy
BGS	British Geological Survey	**RN**	Royal Navy
BH	Borehole	**SAA**	Small Arms Ammunition
BPD	Bomb Penetration Depth	**SQRA**	Semi-Quantitative Risk Assessment
CIRIA	Construction Industry Research and Information Association	**TA**	Territorial Army
CS	County Series	**TARA**	Threat and Risk Assessment
EOD	Explosive Ordnance Disposal	**TNT**	Trinitrotoluene
HE	High Explosive	**UK**	United Kingdom
HSE	Health and Safety Executive	**UN**	United Nations
IB	Incendiary Bomb	**USAAF**	United States Army Air Force
kg	Kilogram	**UXB**	Unexploded Bomb
km	Kilometre	**UXO**	Unexploded Ordnance
LCC	London County Council	**V Weapons**	*Vergeltungswaffen* – Vengeance Weapons
LSA	Land Service Ammunition	**WWI**	World War One
m	Metre	**WWII**	World War Two

Part I: Introduction

1 Document Overview

1.1 Scope of Work

6 Alpha Associates Limited (6 Alpha) has been commissioned in partnership with the *Landmark Information Group* to provide an Unexploded Ordnance (UXO) Threat and Risk Assessment with Risk Mitigation Strategy, for the Site described as "Site at 384813,396894".

1.2 Study Site Location

The Study Site is situated within the *City of Manchester* and totals an area of less than one hectare (ha). The Study Site is centred on *British National Grid Reference* 384812, 396894. An industrial structure is situated within the centre of the Study Site, surrounded by areas of hardstanding ground utilised as car parking space.

The Site's Location and Site Boundary is depicted at Appendices 1 and 2, with aerial photography of the Study Site presented at Appendix 3.

1.3 Aims and Objectives

This document has the following aims and objectives:

1.3.1 Aims

The document aims to assess and evidence the nature and scope of the UXO risks to people, plant, equipment and/or the environment at this Study Site. In the event that an intolerable UXO risk is identified, a recommended UXO risk mitigation strategy will also be articulated.

1.3.2 Objectives

The document has the following objectives:

- To assess the nature and scope of potential UXO contamination at the Study Site;
- To assess whether any UXO contamination generated at the Site is likely to remain extant;
- To consider whether the proposed intrusive works will generate a viable UXO risk pathway;
- To identify those sensitive receptors likely to be impacted by an inadvertent UXO encounter during the proposed intrusive works;
- To assess the UXO risk to those sensitive risk receptors during intrusive works;
- To outline proportional risk mitigation measures that are consistent with a coherent overarching risk mitigation strategy, in order to effectively manage the UXO risk ALARP.

2 Introduction to UXO Risk Management

2.1 Definition of UXO

For the purposes of this risk assessment, *6 Alpha* have adopted the definition of UXO outlined in the undermentioned *CIRIA C681* guide, as follows:

"Explosive ordnance that has been primed, fuzed, armed, or otherwise prepared for use and used in an armed conflict. It may have been fired, dropped, launched or projected and should have exploded but failed to do so…UXO also refers to explosive ordnance that has not been used during an armed conflict, that has been left behind or dumped by a party to an armed conflict, and which is no longer under control of the party that left it behind or dumped it..."

2.2 Generic UXO Threats

There are multiple factors which may have contributed to the UXO contamination of a construction site in the *UK* but generally, UXO contamination is likely to result from the warfighting activity associated with WWI and WWII, the military occupation and use of land such as airfields, camps and training areas; and the manufacture of munitions to support the armed forces.

For example, *WWII Bomb Census* data from the *Ministry of Home Security* calculated that approximately 10% of bombs dropped on *Britain* during WWII failed to function as designed. If the bomb did not detonate when it was dropped, the force of impact enabled the Unexploded Bomb (UXB) to penetrate the ground. Whilst efforts were made to locate and render safe those UXBs that were observed entering the ground (or left behind clear evidence of having done so) during WWII, evidence of such UXBs was readily obscured by bomb damage debris, vegetation and a lack of footfall in some settings – thus, ensuring that an unquantifiable number of UXBs were left *in situ* below the surface of the ground.

Additionally, it has been estimated that at least 20% of the *UK's* land surface area has been used for military training activities or has otherwise been requisitioned for military use historically. Therefore, *British* Abandoned Explosive Ordnance (AXO), Land Service Ammunition (LSA), Small Arms Ammunition (SAA) and aerially delivered ordnance is also commonly encountered in areas that were formerly occupied by military forces (such as *Royal Air Force* (RAF) airfields, military camps and/or military training areas). Conventional and chemical munitions dumping was also prevalent in these periods with little consideration given to future safety implications. There was also widespread unrecorded dumping of LSA and SAA below the ground that was rarely recorded because the activity was often perceived to be inconsequential.

2.3 Generic UXO Risks

The explosive or chemical fill within UXO rarely becomes inert or loses its effectiveness with age, but the explosive fill may change or crystallise over time – increasing the high explosive's sensitivity to a physical shock or an impact. Trigger mechanisms and fuses, which may have failed, may corrode and deteriorate over time, becoming more sensitive to detonation. It is therefore possible that a significant impact on the UXO case, and the resultant effect upon the fuse, may cause its inadvertent detonation.

2.4 UXO Industry Best Practice

In the absence of specific legislation concerning the management of UXO risks during construction projects, the *UK*'s *Construction Industry Research and Information Association* (CIRIA) has published a best practice guide for the assessment and management of UXO risk in the construction industry (*CIRIA* document reference C681). The *CIRIA C681* guide has been judged and recognised by the *Health and Safety Executive* (HSE) as a minimum standard of good practice, that satisfies the law when applied in an appropriate manner.

6 Alpha were *CIRIA's* lead technical author for their *C681* publication and as such, are in a unique position to ensure that Client's manage UXO risk in a safe, cost-effective and time-efficient manner.

2.5 UXO Risk Management Strategic Framework

At Section 5 of *CIRIA's* C681 guide, a framework for the management of UXO risk is articulated and consists of four key stages. These correspond with the framework employed by *6 Alpha*, as presented at Table 1.

6 Alpha Risk Management Framework	UXO Risk Management Phase	CIRIA C681 Risk Management Framework	Delivered within Report? (✔/✘)
UXO Threat Assessment	**STAGE ONE**	Preliminary Risk Assessment	✔
UXO Risk Assessment	**STAGE TWO**	Detailed Risk Assessment	✔
Risk Mitigation Strategy	**STAGE THREE**	Risk Mitigation	✔
Implementation	**STAGE FOUR**	Implementation	✘

Table 1: 6 Alpha and CIRIA UXO Risk Management Frameworks

3 UXO Threat and Risk Assessment Methodology

3.1 Source – Pathway – Receptor Risk Model

The source-pathway-receptor model is a conceptual risk model employed by *6 Alpha* across all projects that informs how UXO risks are assessed. The model also helps to explain the link between the separate sections of this report and the UXO risk assessment at Section 7. The components of the model are as follows:

3.1.1 UXO Sources

The nature and scope of the UXO threat is summarised in the UXO threat assessment (at Section 4) and it forms the source element of the source-pathway-receptor model.

3.1.2 UXO Pathways

The UXO pathways are the routes by which the sources can reach the receptors. UXO pathways are likely to be either by contact and/or through soil energy transfer, through which the resulting shock wave (generated by a UXO source, or sources) may reach potential receptors. Nonetheless, surface events may also generate a through-air risk pathway in which blast and fragmentation from the UXO sources may also reach the receptors.

UXO risk pathways may be generated by a variety of operations that interact with the ground. Therefore, likely operations have been assessed and summarised (at Section 6), to demonstrate the potential risk pathway elements of the model.

3.1.3 UXO Receptors

Receptors are defined as anything which might be adversely affected by the consequences of an inadvertent detonation of any UXO source through an identified pathway. The proximity, robustness, and sensitivity of such receptors is essential in determining their capacity to withstand such high explosive effects and defining what degree of UXO risk might be tolerated (if any).

3.2 Semi-Quantitative Risk Assessment Methodology

The assessment of UXO risk is a semi-quantitative measure of the probability of UXO encounter and initiation and the consequence of an inadvertent UXO initiation; the former being a function of the identified hazard and proposed development methodology and the latter being a function of the type of hazard and the proximity of personnel (and/or other sensitive receptors) to the hazard.

UXO risk is calculated using the following formula:

Risk **(R)** = Probability **(P)** x Consequence **(C)**

3.3 Information Sources

Significant archive research associated with the Study Site has been undertaken to corroborate and to highlight, any and all potential sources of UXO contamination as well as to assess their likelihood of encounter. For the production of this report, *6 Alpha* have reviewed information from the following sources:

- Information gathered from the *National Archives* at *Kew*, including but not limited to:
  - *Ministry of National Security WWII Bomb Census* statistics;
  - *Air Raid Precaution* (ARP) written records and associated bomb strike mapping;
  - Official WWII bomb damage mapping;
- *Ministry of Defence* (MoD) *Abandoned Bomb Register*;
- *Former 33 Engineer Regiment* (Explosive Ordnance Disposal) records at *Carver Barracks, Wimbish*;
- Post-WWII *RAF* aerial photography;
- *County Series* (CS) and *Ordnance Survey* (OS) mapping.

3.3.1 Azimuth© UXO Threat Database

The above list is not exhaustive, and *6 Alpha's Azimuth*© database has also been heavily drawn upon to deliver the UXO threat assessment element of this report. The *Azimuth*© database contains digitised historic charts, aerial photographs and other extensive analogue records from an exhaustive range of additional national, regional and global archives and/or data sets that have been digitised.

3.4 Constraints

This UXO threat and risk assessment is constrained and limited by that information which is reasonably available to *6 Alpha* at the time of writing, as well as that UXO information that is reasonably accessible in a variety of archives, which *6 Alpha* have digitised and georeferenced or have otherwise summarised in written form.

This document may also require updates and changes, especially wherever and whenever the circumstances and factors associated with assessing UXO risk change. For example, if UXO threats are subsequently discovered and they are different from those that have been anticipated, and/or if proposed intrusive operations are significantly changed.

In such circumstances, risks may require re-evaluation and any such changes are to be made by *6 Alpha*, to ensure the continued technical veracity and risk management efficacy of this document.

Part II: UXO Threat & Risk Assessment

4 UXO Threat Assessment

4.1 WWII Aerial Bombing

The *Luftwaffe* bombing campaign of *Manchester* peaked between the 22nd and the 24th December 1940 (the *Manchester,* or *Christmas, Blitz* as it was known) and involved over 400 aircraft delivering more than 460 tons of HE bombs and 37,000 IBs. An estimated 684 people were killed, and a further 2,364 people were injured.

4.1.1 WWII HE Bomb Density

The Study Site was located within *Manchester County Borough,* as presented at Appendix 4. This region recorded six HE bomb strikes per 100 hectares, a "very low" level of bombing. However, further site-specific data has been considered regarding the potential bombing of the Site during WWII.

4.1.2 WWII Luftwaffe Bombing Targets

Luftwaffe aerial reconnaissance photography identified the *Victoria University* (located 305m to the south-west of the Study Site) and the *London Road Railway Station* (located 715m to the north-north-east of the Study Site) as primary bombing targets.

The locations of *Luftwaffe* bombing targets, in relation to the Study Site, are presented at Appendix 5.

4.1.3 WWII Bomb Strikes

During WWII, *ARP* wardens and other local officials compiled detailed logs of bomb strikes across their respective districts that were then often consolidated and mapped at the end of WWII. *ARP* records identified 55 HE bomb strikes were identified within a 1,000m radius of the Study Site, one of which was documented within the north of the Study Site itself. A further 54 HE bomb strikes were recorded impacting within a 1,000m radius of the Study Site, with the closest of these bomb strikes documented between 210m to the north-west and 420m to the north of the Study Site. In addition, six unexploded bombs (UXBs) were identified within a 1,000m radius, the closest of which was located 475m to the north-east of the Site. *ARP* records also identified 165 incendiary bombs (IBs) within 1,000m, the closest five which were documented between 85m to the north-west and 260m to the south-east.

In addition to IBs and HE bomb strikes, during the latter stage of WWII, when more conventional aerial bombardment of the *UK* had significantly declined, the main threat came from *V* type weapons. *V1* and *V2* rockets were thin-skinned, unmanned and inaccurate weapons and generally exploded upon impact and thus, are less likely to pose a UXO threat. There is no evidence to suggest that the Study Site (or its immediate vicinity) was subjected to rockets strikes during WWII.

The locations of WWII-era bomb strikes, in relation to the Study Site, are presented at Appendix 6.

4.1.4 WWII Bomb Damage

Official bomb damage mapping associated with the Study Site was not available, but an analysis of post-wartime mapping and aerial photography identified that several residential structures in the north of the Site were demolished as a result of the HE bomb strike on what was then *Robert Street* (now *Kincardine Road*). Further evidence of potential bomb damage was recorded within the immediate vicinity of the Study Site boundary, including to *Cottenham Street* (located 35m to the south-east), to *Upper Brook Street* (located 55m to the south-west) and to *Arkley Street* (located 65m to the north-east).

Extensive archival research similarly documented significant bomb damage to structures located along *Oxford Road* (275m to the south-west), to the *Ardwick Picture House* (located 475m to the north-east), and to the *St Thomas's Church* (located approximately 520m to the north-east).

WWII bomb damage mapping covering the Study Site and its surrounding area is presented at Appendix 7.

4.1.5 UXB Entry Holes

The CS mapping prior to WWII (1932) and aerial photography (1946) shows that the Study Site was situated within a densely developed area, with the Site itself consisting of several structures and hardstanding ground. Therefore, it is likely that the Study Site would have been accessed frequently during WWII and as such, there an elevated likelihood that any clearly visible UXB entry points would have been observed and recorded at the time.

However, given that evidence of significant bomb damage was identified on-site and within the immediate vicinity of the Study Site boundary, it is possible that bomb damage debris could have concealed UXB entry points, causing them to have gone unnoticed.

4.2 *British* Military Activity

Although there is no evidence to suggest that the Study Site itself or its immediate vicinity has previously been occupied by military personnel, there is some evidence of military activity within the wider area, as detailed below:

4.2.1 Historic Military Activity

Ardwick Green (located approximately 425m to the north-east of the Study Site) was selected as the *Headquarters* of the *5th (Ardwick) Volunteer Battalion of the Manchester Regiment* in the late-1880s, with the *Ardwick Green Barracks* officially opening in September 1887. By 1908, the *5th (Ardwick) Battalion* had evolved into the *8th Battalion*. Troops of the *8th (Ardwick) Battalion* were subsequently mobilised within the drill hall at the *Ardwick Green Barracks* in August 1914, before being deployed to the *Western Front* during WWI.

The *Ardwick Green Barracks* remained operational during WWII, with the barracks primarily utilised as a detention centre of soldiers who had deserted. After WWII, the barracks were restored for the use as the *Headquarters* of the *8th (Ardwick) Battalion of the Manchester Regiment*. Later on in 1967, the *Ardwick Green Barracks* became home to the *Manchester Regiment (Ardwick and Ashton) Territorials*, then later to the *C Company of the 5th/8th (Volunteer) Battalion of the King's Regiment*.

From 2006, the *Ardwick Green Barracks* were home to the *D (Inkerman) Company of the 4TH Battalion of the Duke of Lancaster's Regiment*. However, the barracks were vacated in 2018 and were put up for sale the following year. Therefore, it is possible that munitions may have been stored or otherwise located in the wider area; though such activity is unlikely to have generated a UXO hazard at the Site itself.

4.3 Previous UXO Encounters

An analysis of historic records noted several UXO encounters within the vicinity of the Study Site, as follows:

4.3.1 Abandoned Bombs

The Abandoned Bomb register was compiled from wartime records and was published in the form of a written answer to the *House of Commons* in 1996. The list initially only covered abandoned bombs in *London* but has since been released for the rest of the UK.

An examination of the *MoD*'s official abandoned bomb records has not identified any abandoned bombs on-site nor within a 1,000m radius.

4.3.2 WWII UXO Disposal Tasks

An examination of pertinent historical records associated with the Study Site has identified at least six unexploded bombs (UXBs) as being disposed of within a 1,000m radius of the Study Site boundary during WWII, the closest of which was located 475m to the north-east.

4.3.3 Post-WWII UXO Encounters

An examination of pertinent historical records associated with the Study Site has not identified any post-WWII UXO encounters on-site nor within a 1,000m radius.

4.4 UXO Threat Summary

Given the evidence presented above, *6 Alpha* consider it reasonably foreseeable that a UXO encounter could occur at this Site. The most probable UXO threat items are *German* HE bombs and IBs. *British* AAA projectiles may also pose a residual threat, which were likely fired in the defence of the local area during WWII bombing raids.

5 UXO Burial Depths

5.1 Overview

It is important to establish the likely burial depth for threat spectrum UXO at the Study Site. The potential penetration depth of an UXB was dependent on a number of factors including but not restricted to those prior to striking the ground (e.g. velocity and orientation of the UXB), which in turn will be influenced on factors such as the release altitude from the aircraft and encounters with infrastructure during its fall; those encountered at the point of impact (i.e. was the impact on concrete, grass, water etc.) and finally, the below ground level conditions (e.g. infrastructure/services, basements, foundations, and geology).

Accordingly, the ground conditions at the Study Site must be understood in order to determine the average and maximum *German* UXB penetration depths, as well as the potential for other types of munitions to be buried. The provenance of made ground must also be considered in order to accurately determine the ground levels at the time when UXO contamination may have occurred (so as to accurately determine the average/maximum bomb penetration depths) and subsequently to inform any further recommendations.

5.2 Ground Conditions

The Client has described the ground conditions as follows:

- *"The geological map for the area suggests the site is underlain by Till overlying Chester Sandstone Formation. Three BGS archive boreholes are located on or very close to the site and these indicate around 4m of made ground and/or sand and gravel overlying sandstone."*

In addition, an analysis of *BGS* mapping associated with the Study Site suggests that the Site is likely to be underlain by a bedrock of "*Chester Formation - Sandstone*".

5.3 UXB Burial Depths

Based on the ground conditions described above, the average BPD for a 250kg *German* HE bomb is assessed to be approximately 5m bgl, with the maximum BPD considered to be approximately 10m bgl.

Although it is possible that the *Luftwaffe* deployed larger bombs in the area, an analysis of WWII bomb census data clearly evidences that their deployment was infrequent. Therefore, to use such larger bombs for BPD calculations **are not justifiable under the ALARP principle and thus, CIRIA C681 guidance**.

WWII *German* bombs have a greater penetration depth when compared to IBs and AAA projectiles, which are unlikely to be encountered at depths greater than 1m bgl.

5.3.1 The J-Curve Effect

As a UXB penetrated the ground, it's velocity naturally slowed where it either came to an abrupt stop (e.g., against foundations) or would continue along a route of least resistance – which often resulted in a curving of the trajectory back towards the surface. This is known as the "J Curve" effect and often resulted in a considerable horizontal off-set from the point of entry. This explains why UXBs have been discovered against or under the foundations of buildings which were present during WWII, or many meters from their entry holes. A diagrammatical representation of the "J Curve" effect is presented at Figure 1.

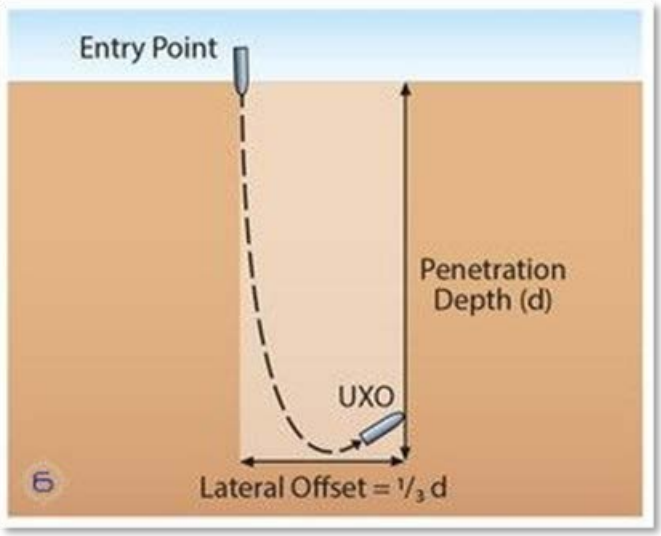


Figure 1: The "J Curve" Effect

6 UXO Risk Pathways

6.1 Overview

In order to assess whether a viable UXO risk pathway might exist at the Study Site, potential UXO contamination sources must be assessed (and have been at Section 4 of the report) and the likely depth of UXO contamination ought to be established (as per Section 5 of the report). Additionally, the Site's construction history ought to be considered to assess whether any previous intrusive works will have encountered and removed any UXO contamination present at the Site.

6.2 Study Site Construction History

From an analysis of CS and OS mapping, together with aerial photography, the following site history can be deduced:

Year	Development History
1932 CS Map	The Study Site was situated within a densely developed area, with the Site itself consisting of several structures and hardstanding ground.
1946 Aerial Photography	Residential structures in the north of the Site had been demolished and cleared.
1969 OS Map	Several structures located in the north-eastern sector of the Study Site had been cleared.
1978 OS Map	Changes were not recorded at the Study Site.
1992 OS Map	The remaining structures had been cleared from the Study Site, with a larger structure developed across the majority of the Site. The structure was surrounding by hardstanding ground utilised as car parking space.
2003 Aerial Photography	Changes were not recorded at the Study Site.
2016 OS Map	Changes were not recorded at the Study Site.
2024 OS Map	Changes were not recorded at the Study Site.

Table 2: Study Site Development History

As per Table 2, it is apparent that the Study Site has undergone notable post-WWII developments, with bomb damaged structures cleared across the Site by 1946. The remainder of the pre-existing structures were cleared from the Site by 1992. At that time, the existing structure appears to have been built across much of the Site, along with areas of hardstanding. Consequently, it is considered likely that any UXO contamination within ground that has been disturbed since WWII would likely have been discovered and removed.

Nonetheless, it is apparent that the previous intrusive works are unlikely to have mitigated the UXO risk in all areas of the Study Site down to the likely average UXO burial depth of 5m bgl.

6.3 Proposed Works

An outline of the proposed intrusive works is also presented in order to evidence the potential UXO risk pathways that may be generated, should such work encounter those threat spectrum UXO that have been identified in Section 4.

A general overview of the scope of works for the project has been communicated to *6 Alpha* and consists of:

- *"Medium Trial Pit between 1m and 5m below ground level;*
- *Seven boreholes to 20m depth plus three trial pits to 3m depth;*
- *Excavation Depth: 3m."*

Consequently, it is apparent that the proposed works might generate a UXO risk pathway in ground that has not been previously disturbed (including any ground below post-WWII intrusive work) to a depth of 5m bgl.

If the planned methods are changed, then the risk assessment is to be reviewed and updated if necessary.

7 UXO Risk Assessment

7.1 Threat Items

The most probable sources of UXO risk at this Study Site are *German* HE bombs and IBs, whilst *British* AAA projectiles may pose a residual threat. The consequences of initiating *German* HE bombs are generally more severe than initiating IBs or AAA projectiles, and thus they pose the greatest prospective risk to intrusive works.

7.2 Risk Pathways

Given the nature and scope of the prospective UXO hazard at the Study Site, all types of aggressive intrusive activities (i.e., investigative groundworks and construction methodologies) into previously undisturbed ground (including ground below any post-WWII redevelopment) to a depth of 5m bgl may generate a significant risk pathway.

7.3 Risk Receptors

The likely risk receptors include:

- Site personnel;
- Plant and equipment;
- Third-party infrastructure (utilities/services) and buildings;
- The natural environment.

Consequences of UXO initiation include:

- Injuries and/or fatalities to personnel;
- Damage to plant and equipment, nearby buildings and infrastructure;
- Rupture and damage underground utilities/services and the natural environment.

Consequences of an unexpected and unplanned UXO discovery include:

- Incurring delays and additional costs through the expenditure of additional risk mitigation resources and EOD clearance;
- Disruption to local community;
- Negative publicity.

7.4 Semi-Quantitative Risk Assessment

A semi-quantitative risk assessment has been undertaken and the results of the SQRA are presented at Table 3.

Activity	UXO Threat Item	Probability (SH+EM=P)	Consequence (D+PSR=C)	Risk (PxC=R)
Trial Pits	Aerial Bombs	2+2=4	3+3=6	**4x6=24**
	AAA Projectiles	1+2=3	3+1=4	**3x4=12**
Boreholes	Aerial Bombs	2+3=5	3+2=5	**5x5=25**
	AAA Projectiles	1+3=4	3+1=4	**4x4=16**
Excavations	Aerial Bombs	2+2=4	3+3=6	**4x6=24**
	AAA Projectiles	1+2=3	3+1=4	**3x4=12**

Table 3: UXO SQRA Results

7.4.1 SQRA Conclusions

The SRQA has determined that the proposed intrusive works may generate, as a reasonable worst-case scenario, a ***HIGH*** level of risk at the Study Site. Such risks may pose harm to human health and damage any equipment involved in intrusive activities, the former are intolerable. Therefore, such risks will require mitigating in accordance with the ALARP principle, as per Part III of this report.

Part III: UXO Risk Mitigation Strategy

8 UXO Risk Mitigation Strategy

8.1 Strategic Overview

As per *CIRIA* C681 guidance, *6 Alpha* recommended that the identified UXO risks are reduced ALARP. Crucially, the ALARP principle states that if the cost of reducing a risk significantly outweighs the benefit, then the risk may be considered tolerable. This does not mean that there is never a requirement for UXO risk mitigation, but that any mitigation must demonstrate that it is beneficial. Any additional mitigation that delivers diminishing benefits and that consumes disproportionate time, money and effort are considered *de minimis* and thus unnecessary. Because of this principle, UXO risks will rarely be reduced to zero (nor need they be).

Consequently, the following proactive and reactive UXO risk mitigation measures ought to be implemented ahead of proposed intrusive operations at the Study Site in order to reduce the identified UXO risks to ALARP.

8.2 Proactive UXO Risk Mitigation Measures

The following proactive risk mitigation measures should be undertaken prior to the commencement of intrusive works:

8.2.1 EOD Engineer in the Watching Brief Role

Where "open" intrusive works into previously undisturbed ground are proposed, an EOD Engineer should be present in the UXO Watching Brief role to monitor ongoing "open" intrusive works to identify any suspicious items that may be UXO related (this service can be provided by *6 Alpha*).

8.2.2 Intrusive Magnetometer Survey

Where "blind" intrusive works into previously undisturbed ground are proposed, an intrusive UXO survey (employing down-hole magnetometer or *MagCone* techniques) is strongly recommended. Such a survey should extend to the **assessed average bomb penetration depth of 5m bgl** or to the maximum depth of the works, whichever is encountered first, or until geology is encountered through which it is assessed a UXB would not penetrate, to identify for signs of sub-surface anomalies which may model as threat spectrum UXO in advance of said works. (This service can be provided by *6 Alpha*).

8.2.3 Geophysical UXO Survey Efficacy

Certain ground conditions may constrain geophysical UXO survey, as magnetometer survey is adversely affected in mineralised and made ground. Nonetheless, *6 Alpha* can advise the likely efficacy of such survey work in advance of their trial and implementation as and when required.

8.3 Reactive UXO Risk Mitigation Measures

The following reactive risk mitigation measures should also be undertaken for all activities in all areas:

8.3.1 Operational UXO Emergency Response Plan

Appropriate site management documentation should be held on-site to guide and plan for the actions which should be undertaken in the event of a suspected or real UXO discovery (this plan can be supplied by *6 Alpha*).

8.3.2 UXO Safety and Awareness Briefings

The briefings are essential when there is a possibility of an explosive ordnance encounter and are a vital part of the general safety requirement. All personnel working on the Site should receive a briefing on the following:

- The identification of threat spectrum UXO;
- What actions they should take to keep people and equipment away from such a hazard and to alert site management.

Information concerning the nature of the UXO threat should also be held in the site office and displayed for general information on noticeboards - both for reference and as a reminder for ground workers.

The safety awareness briefing is an essential part of the *Health & Safety Plan* for the site and helps to evidence conformity with the appropriate health and safety standards and legislation.

8.4 ALARP Safety Sign Off Certification

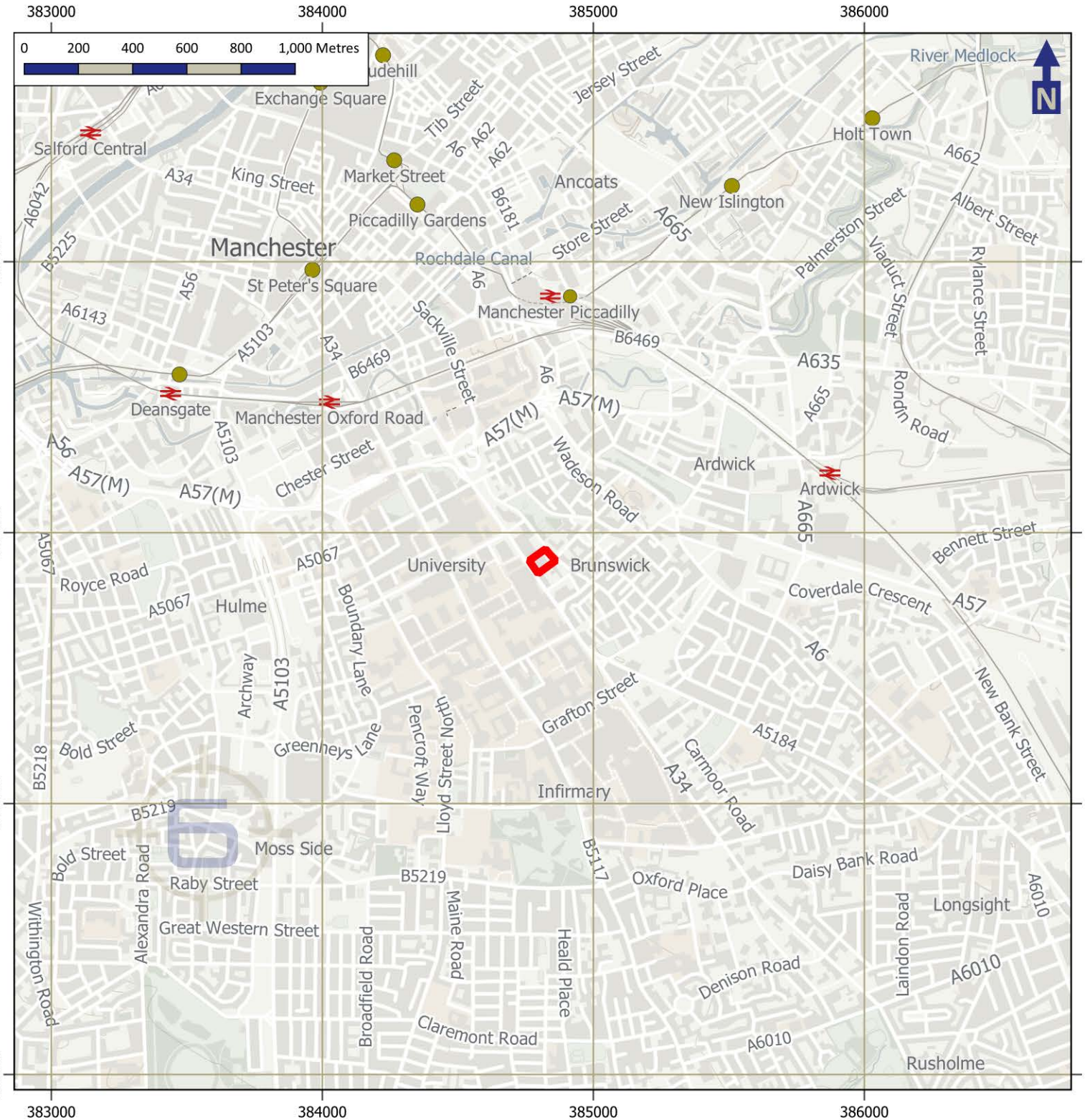
ALARP safety sign-off certification provides an independent source of evidence that a Client has followed industry best practice and has successfully managed and reduced UXO risks to ALARP. Following the execution of *6 Alpha's* UXO risk mitigation measures, we can deliver ALARP safety sign-off certification, in advance of the proposed operations.

In such circumstances the project will be able to certify for the benefit of all of its stakeholders, that all reasonably practicable measures have been taken to protect contractors from UXO hazards and that the commissioning Client will have acted in compliance with industry best practice as well as the national safety legislation.

In accordance with best practice therefore, *6 Alpha* ALARP safety sign-off certification does not imply that any site is free from UXO, rather, that the necessary and appropriate UXO risk mitigation measures have been appropriately applied to evidence that UXO risks have been reduced ALARP.

8.5 Recommended Next Steps

We recommend that the Client's next steps are focused upon phase four of the UXO Risk Management Framework namely, the detailed designs of the recommended UXO risk mitigation measures as outlined above. The specifications are to be delivered and the UXO risk mitigation measures are to be executed in advance of the GI and construction phases of work, in order to warrant and to evidence that UXO risks can be mitigated and reduced to ALARP.



Site Location

BOMB SEARCH

LEGEND

Site Boundary



British National Grid

Address

SITE AT 384813, 396894

PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE
11217	1	BS	LG	30/04/2024

alpha ASSOCIATES
special risks consultancy

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Appendix 2 – Site Boundary



Site Boundary

BOMB SEARCH

LEGEND

Site Boundary



British National Grid

Address

SITE AT 384813, 396894

PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE
11217	2	BS	LG	30/04/2024

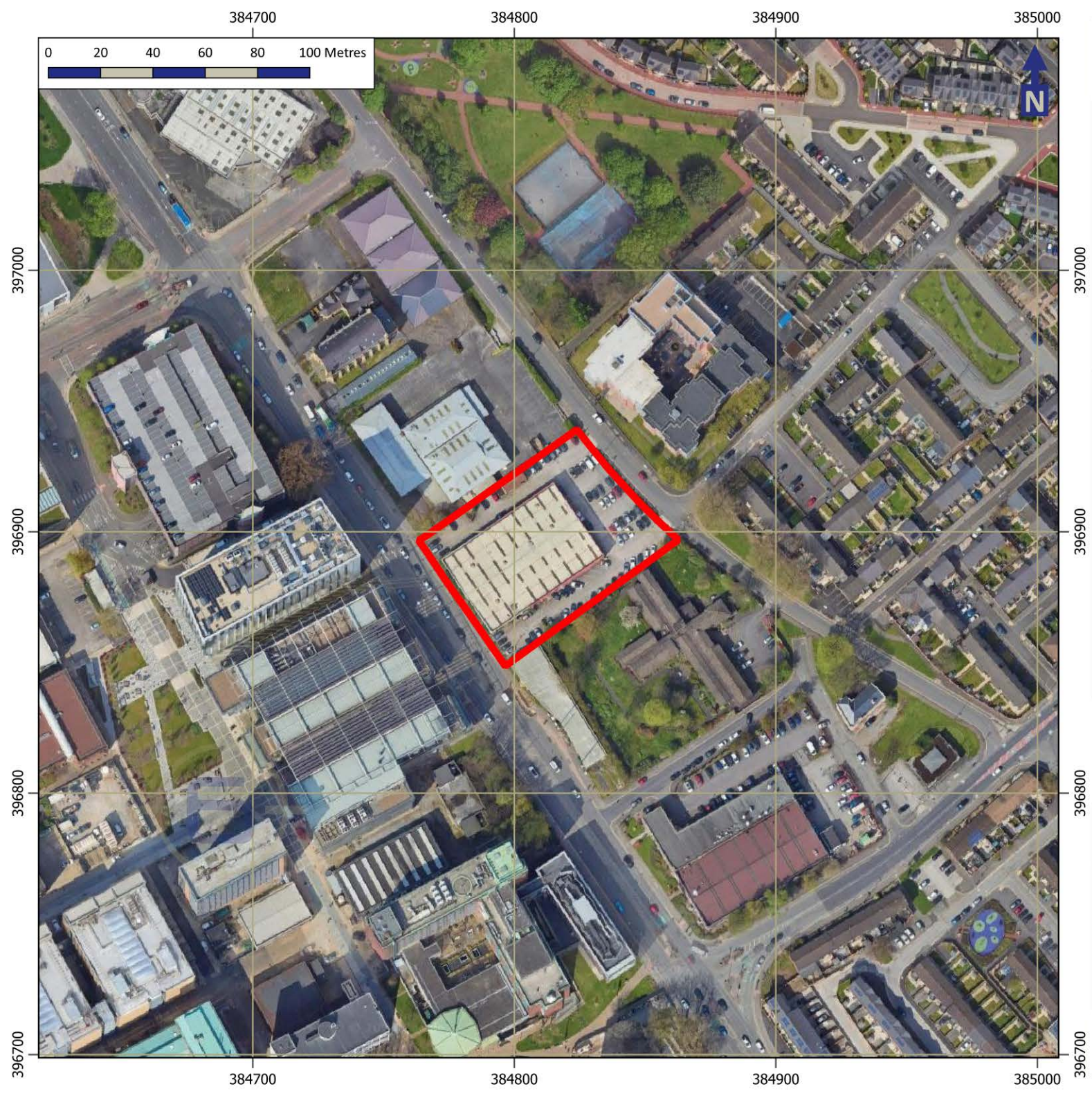
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Appendix 3 – Modern Aerial Photography



Modern Aerial Photography

BOMB SEARCH

LEGEND

Site Boundary



British National Grid

Address

SITE AT 384813, 396894

PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE
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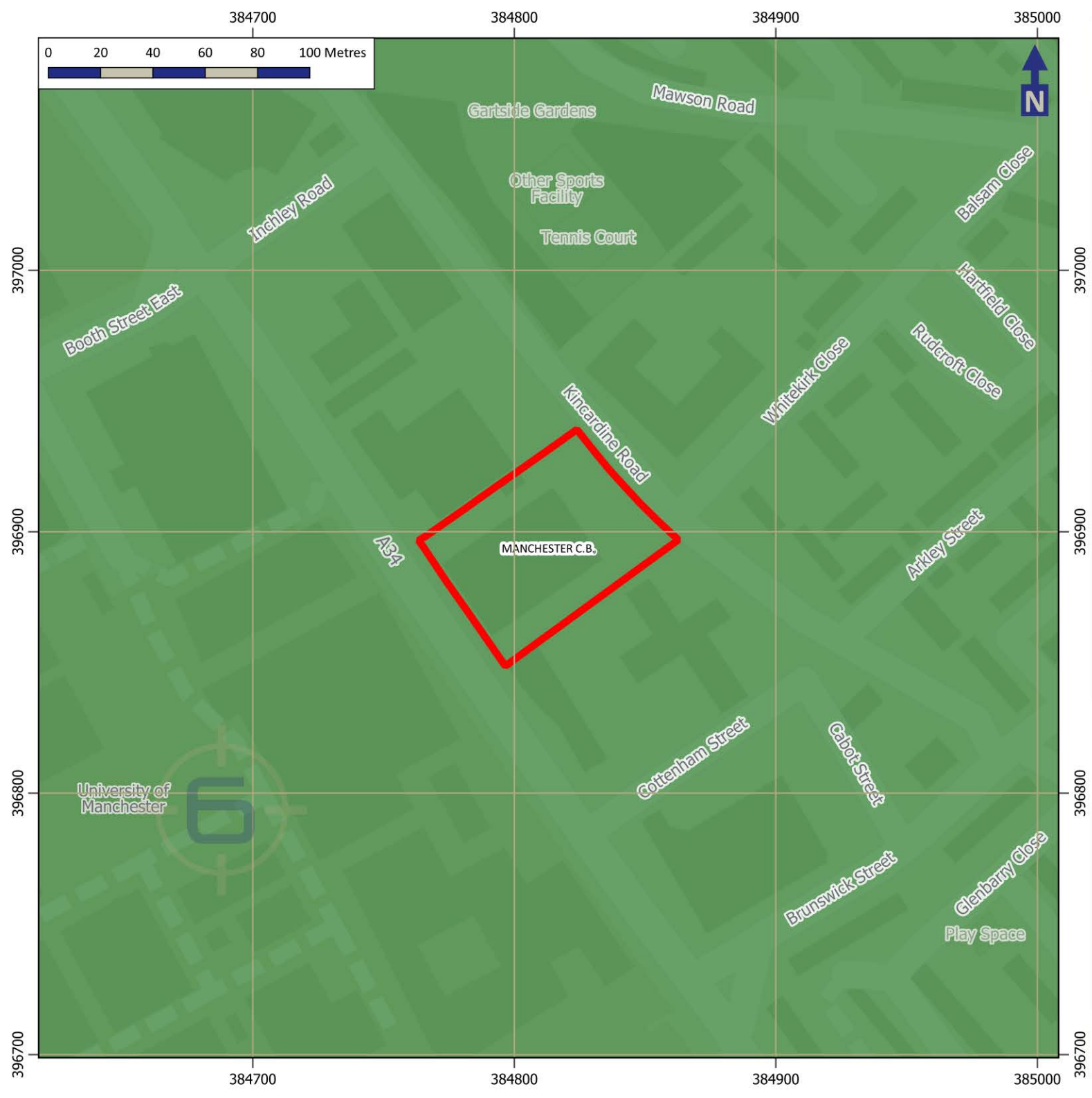
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Map data: Google, The GeoInformation Group, Infoterra Ltd, Bluesky, Getmapping plc

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Appendix 4 – WWII High Explosive Bomb Density



WWII High Explosive Bomb Density

BOMB SEARCH

LEGEND

Site Boundary

High Explosive Bomb Density

- Less than 15 bombs per 100 hectares
- 16-25 bombs per 100 hectares
- 26-35 bombs per 100 hectares
- 36-45 bombs per 100 hectares
- Over 46 bombs per 100 hectares



British National Grid

Address

SITE AT 384813, 396894

PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE
11217	4	BS	LG	30/04/2024

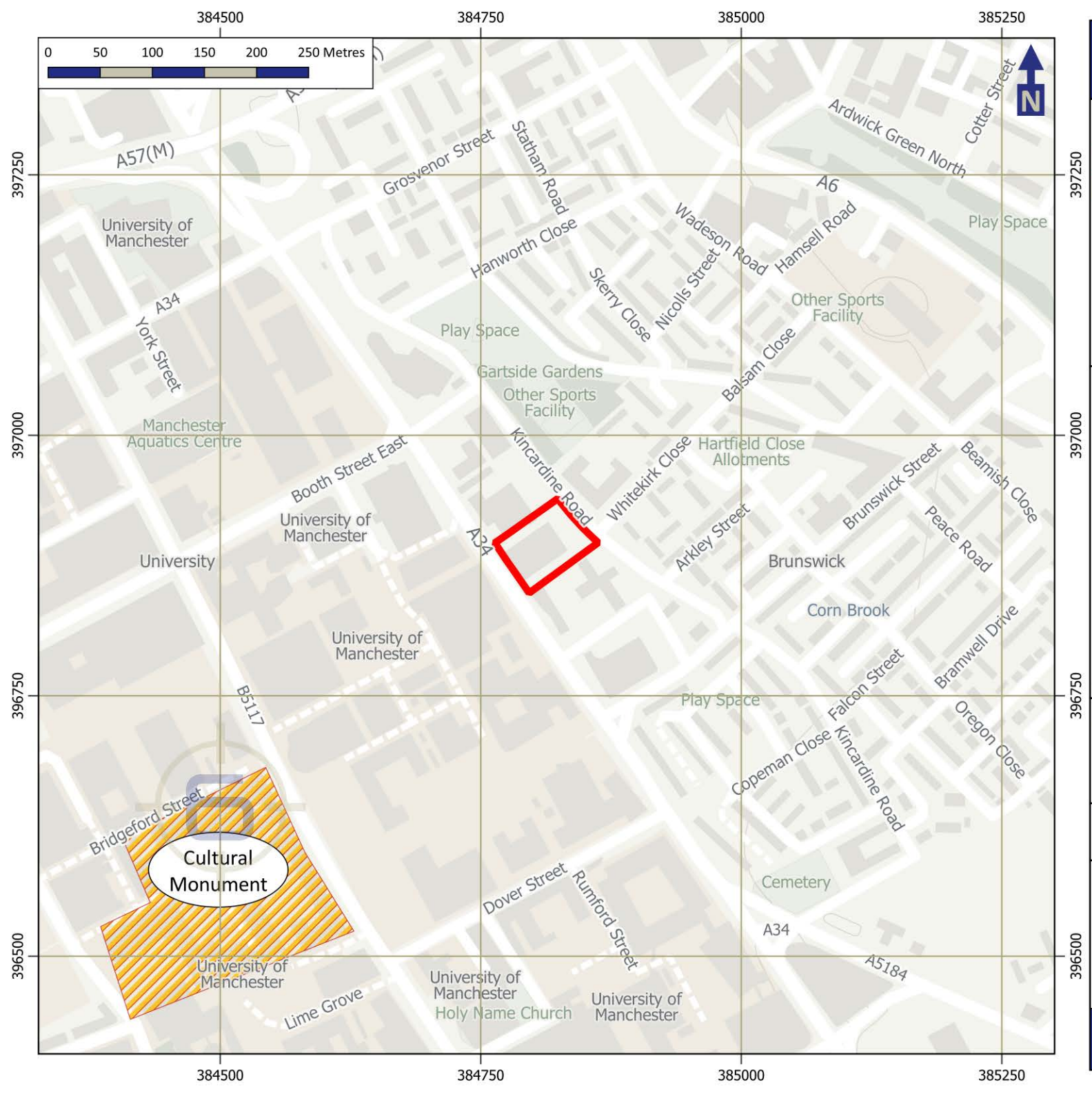
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Appendix 5 – WWII Luftwaffe Bombing Targets



WWII Luftwaffe Bombing Targets

BOMB SEARCH

LEGEND

- Site Boundary
- Luftwaffe Target



British National Grid

Address

SITE AT 384813, 396894

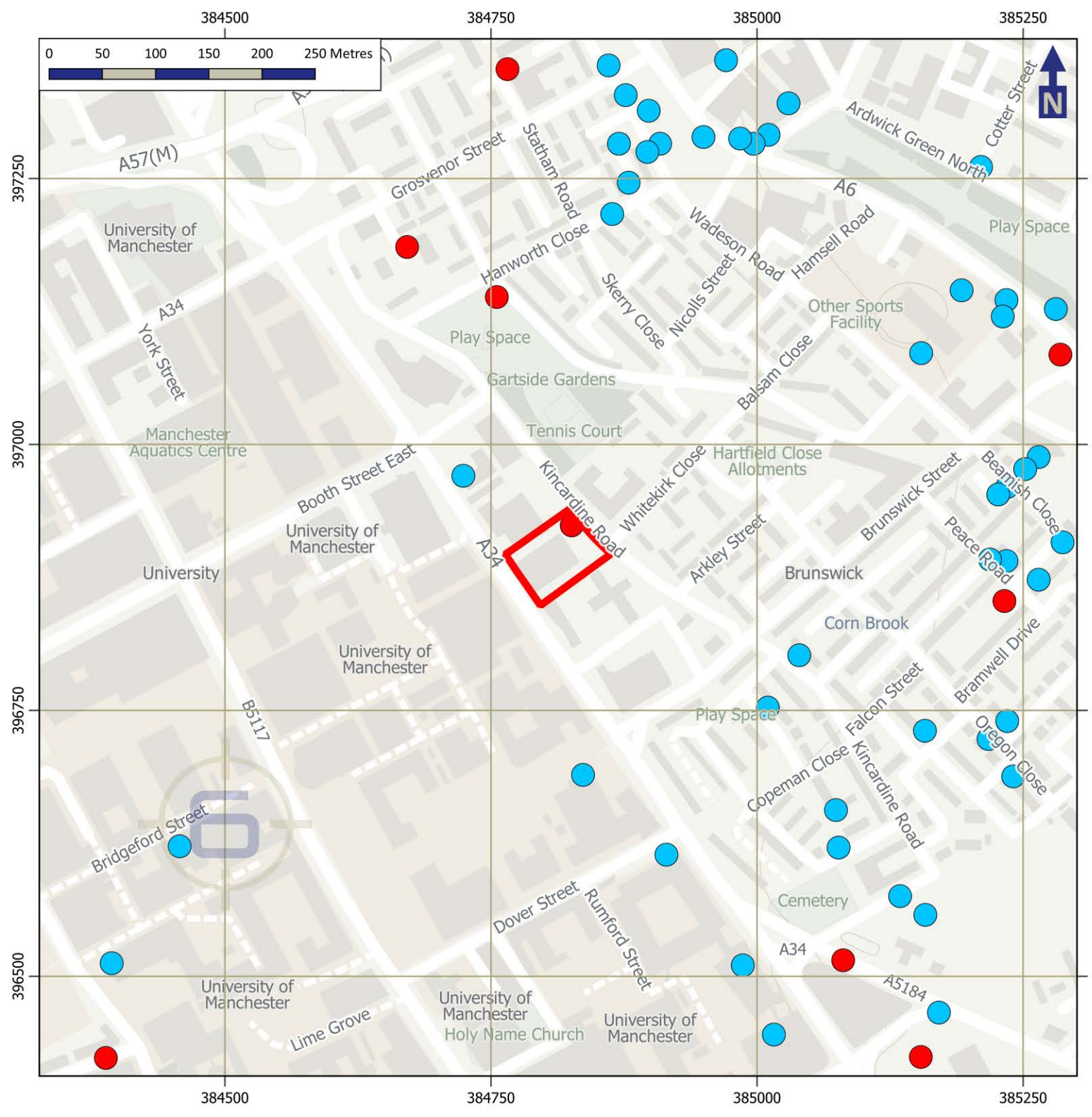
PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE
11217	5	BS	LG	30/04/2024

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WWII Bomb Strikes

BOMB SEARCH

LEGEND

Site_Boundary

Consolidated Bomb Strikes

- High Explosive Bomb
- Incendiary Bomb



British National Grid

Address

Site at 384813,396894

PROJECT NO.	FIGURE	DRAWN	CHECKED	DATE
11217	6	LG	BW	07/05/2024

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APPENDIX C:
SUMMARY OF KEY PROJECT SPECIFIC HAZARDS

Initial items to be considered

- Excavations
- Confined Spaces
- Temporary Works
- Overhead Services
- Below ground services
- Environmental protection
- Contaminated land
- Asbestos
- Protection of the edges of all excavations with exposed edges.
- Penetrating works with regard to existing services and UXO
- Work at height
- Deliveries
- Dust
- Noise
- Vibration
- Manual Handling
- Demolition
- Uncontrolled Collapse
- Adjacent Land users
- Traffic management