

Remediation Strategy for M4 .1 City Road East, Manchester,

Project No: NX406/R1

Planning Ref: Application No: CDN/23/0775



Client

MARSHALL

DOCUMENT VERIFICATION**Report Reference:** NX406/R1 **Issue:** Final **Date:** 29th January 2024**Reviewed by:** Matthew Tomkinson
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Revision History

Revision	Date	Description	Reviewed by	Approved by
Issue	December 2023	Final		
R1	January 2024	Inclusion of proposed gas protection measures and updated cover system protocol		

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EXECUTIVE SUMMARY

NX Consulting Limited (NX) have been commissioned by Marshall CDP (The Client) to conduct a remediation strategy on land at One City Road East, Manchester, M15 4PN.

It is understood that the site is currently developed with 4no. connected commercial office buildings which are proposed to be demolished and replaced with 2no. blocks of 11-14 storey commercial office buildings with associated car parking and limited landscaping areas.

The remediation strategy is based upon a single philosophy which provides a detailed understanding of the chemical and physical properties of the ground, groundwater, surface water and ground gas, established by way of extensive desk study, intrusive ground investigations, laboratory testing and monitoring. In addition, an assessment of how the remediation is to be achieved shall be approved and upon completion a validation report shall be submitted to the Directorate of Planning of Manchester City Council.

The above approach will involve a 'best sustainable approach' to remediation of potential contamination; involving a minimal approach with respect to the removal and disposal of contaminated materials from site. A minimum amount of material will be taken off site thus conserving landfill space locally and minimising lorry movements onto local roads from the site.

Geological mapping shows drift deposits to comprise Glaciofluvial Sheet Deposits (Sand and Gravel) beneath the site. Mapping indicates the solid geology to comprise Sandstone of the Chester Formation.

Site investigation works were undertaken between 11th July 2023 and 17th July 2023, and the supplementary fieldworks were undertaken between 25th & 27th July 2023 and on 3rd & 4th August 2023. Both intrusive investigations were carried out by Taylor Drilling Services Ltd and monitored by an engineer from NX Consulting.

Made Ground was identified within all exploratory hole locations to maximum proven depths of 4.90m bgl (where deposits were able to be fully penetrated). Deposits were noted to comprise sands and gravels with a high content of cobbles and boulders which comprised bricks, concrete and general demolition backfill. It is probable that when historical buildings on the site were demolished much of the material was backfilled on site and possibly into former cellars associated with the former buildings.

Drift deposits were encountered in the majority of exploratory holes during the site works between depths of 0.25m to 7.50mbgl. Deposits were found to comprise an initial layer of Glacial Sand and Gravel was typically loose to medium dense light brown, underlain by Glacial Till comprised brown typically firm to stiff clay (locally soft to firm), exhibiting a consistent trend of increasing stiffness with depth, underlain by probable Glaciofluvial drift deposits comprising dense red/brown SAND AND GRAVEL.

Alluvial deposits were found in WS05 (3.65m – 5.0mbgl), WS11 (3.20m – 5.00m bgl), and BH01 (3.60m bgl to 6.50m bgl). These deposits included soft to firm grey-brown clayey silt and/or loose to medium dense light grey silty clayey sand. Some areas also contained soft silty clay, fine gravel, peat laminations and layers of with sand and gravel.

Solid geology was encountered within both of the 2no. rotary core boreholes at depths between 6.00-22.50mbgl and noted to comprise weak to medium strong reddish brown fine to coarse grained SANDSTONE with rare mineral inclusions and intraclasts. Subhorizontal bedding fractures, thinly spaced, planar, smooth to slightly rough were also noted upon recovered core runs.

Recovery was often poor within 5.00m and 7.00m were the rock being poorly cemented. This generally improved as drilling progressed. Irregular bands of marl were observed between 7.00m and 9.00mbgl within RBH02, and at 13.50mbgl within RBH01. The marl appeared

medium brown in colour. The colour of the sandstone generally remained reddish brown throughout, with some areas appearing light brown in colour.

Groundwater was recorded during the site investigation works within 2no. window sampler boreholes between depths of 3.0m to 3.50mbgl.

The post-development foundation system cannot be confirmed until a Design and Build Contractor is appointed to construct the development project. Based on information provided to date, a bored piled solution is the most suitable solution for the proposed building. A piling mat will be required in line with BRE470 Working Platforms for Tracked plant as part of the enabling works.

A piling risk assessment is recommended and should be carried out to establish the most suitable choice of pile to reduce migration pathways for potential soil and groundwater contamination into the underlying aquifer.

The proposed works comprise site reprofiling, preparation of development platforms. Where possible site soils are to be retained on site to reduce disposal costs.

Unsuitable materials, that cannot be reused on site, will require removal from site to suitably licensed waste management facility. A degree of surface and subsurface treatment should be anticipated within all areas comprising excavation, crushing, screening and/or removal from site.

The environmental chemistry results together with the findings of the intrusive investigation are consistent with the site's historical uses. Elevated concentrations of contaminants of lead, Naphthalene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene have been identified in 3no. of the samples tested. Chrysotile asbestos and amosite were also identified during asbestos screening in 1no. samples. As such, it is recommended that these soils not be utilised within shallow soils in landscaped or area of Public Open Space (P.O.S) areas as part of the redevelopment.

Once the works are completed, contaminants will be isolated beneath buildings and areas of hardstanding, direct contact with asbestos fibres and heavy metals remain a potentially viable pathway in landscaping and P.O.S Area scenario.

The proposed remediation or mitigation will comprise the following:

- Excavation & removal from site of granular and cohesive made ground with heavy metals asbestos fibres from areas where future site levels are to be reduced.
- Placement of clean cover soil system within of soft landscaping, public open spaces or commercial gardens; where site levels are to be raised.
- Removal and replacement with "clean cover" systems within soft landscaping, public open spaces or commercial gardens where site levels are to be more or less unchanged.

The depths of material to be removed or the thickness of a soil barrier shall comprise the following:

- Within areas of soft landscaping a minimum 600mm of clean cover / removal & replacement of made grounds should be assumed.
- Within areas of areas of public open space to be grassed; a minimum 600mm of clean cover / removal & replacement of made ground should be assumed.
- If a geotextile is adopted then drainage should be introduced within the cover system layer to prevent waterlogged conditions within landscaped and P.O.S areas.

Where the made ground materials are less than 600mm thick, only the Made Ground materials will require removal.

In areas of the site where buildings and hardstanding are proposed the Made Ground can be left in-situ as the buildings and hardstanding areas will break the 'pollutant linkage' and remove the pathway for contamination and come in to contact with the end users.

Cover system depths and sample ratios should be carried out in line with Section 6 of Manchester City Council's Planning and Technical Guidance document relating to ground contamination, dated February 2021.

Obstructions in the form of relic foundations, infrastructure, oversize Made Ground materials are likely to be found on site during groundworks. Particularly within the areas of the former buildings. Pre-auguring may be required for any pile design. It is recommended that these materials are 'grubbed out' and treatment (screening/crushing/segregation and reused (where appropriate) on site as part of the site preparation. Materials unsuitable for reuse on site will require removal from site to suitably licensed waste management facility.

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

Asbestos Containing Material (ACM) were found during soil sampling of Made Ground. As a contingency measure and to protect construction workers and adjacent receptors from any unidentified asbestos contamination, we recommend that any identified ACM, found during the site enabling works should be dealt with in strict accordance with the Control of Asbestos Regulations (CAR) 2012, UK Waste Management Legislation and the Environmental Protection Act 1994. The following protective measures should be adopted during the proposed ground preparatory works:

- All site personnel should be provided with PPE.
- A water bowser or other dust suppression equipment should be provided in order to dampen exposed surfaces; during the movement of plant and removal of arisings.

The risks to controlled water receptors are deemed to be low post construction.

GSV values fall into Characteristic Situations 2 and gas protection measures should be installed beneath all buildings in accordance with BS8485: 2015. Gas protection measures should be installed as prescribed in BRE 414 with the ventilation of the sub-floor void designed to provide a minimum of one complete volume change per 24 hours. Independent validation of gas protection measures is needed to achieve the required points score. NX have been provided with detailed drawings by Booth King Partnership which are available in Appendix a of this document.

Soil testing to date indicates that there is a low risk of vapour generation and migration into the proposed buildings. No specific protection measures are envisaged in relation to hydrocarbon contamination. A watching brief should be carried out on site and if solvent/hydrocarbon contamination recorded then NX should be notified and further testing carried out to establish potential risks and any required vapour protection measures.

Any imported subsoil/topsoil materials will require chemical validation to demonstrate that they are suitable for a commercial end use and taken to depths sufficient to provide a sufficient cover system for all proposed materials used which are capable to support root growth.

Materials surplus to requirement or that are unsuitable for re-use on site will require removal to a suitably licensed waste management facility. Soil samples have been characterised against hazardous waste criteria using HazwasteOnline. Any soils to be exported from site should be allocated an appropriate waste code, following the steps within WM3. The results appended to this document indicate that the majority of samples tested are likely to predominantly be classified as NON-HAZARDOUS WASTE. However, some areas of Made Ground soils have been classified as HAZARDOUS.

Waste Acceptance Criteria (WAC) testing will be required prior to the disposal of site soils, if exported to landfill.

Soil operations may be subject to regulation using a 'Materials Management Plan' (MMP) to be created in accordance with Version 2; of the CL:AIRE Definition of Waste – Industry Code of Practice. If so, the MMP should be created with due consideration to all proposed remediation and enabling works operations prescribed within this document and should be undertaken by a Qualified Person and a signed declaration submitted to the EA prior to re-use of materials on the site.

The results indicate that specialist protection measures may be required in relation to the water supply pipework. A UKWIR risk assessment is recommended and testing is required once the line of any new pipework, is established, to confirm whether or not specialist measures are required.

The regional unexploded bomb risk map from Zetica indicates that the site is in an area at moderate risk from possible Unexploded Ordnance (UXO) resulting from the Second World War. (Zetica, 2020). A Preliminary Unexploded Ordnance (UXO) Risk Assessment is recommended.

The design team and Client should familiarise themselves with the presence of utility services on the site.

Once the whole site has been remediated; validation and approval from the Local Planning Authority will be required via a validation report encompassing all the findings of the remediation works on this site.

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1.0 INTRODUCTION

1.1 Instruction

NX Consulting Limited have been commissioned by Marshall CDP (The Client) to conduct a remediation strategy on land at One City Road, Manchester, M15 4PN.

It is understood that the site is currently developed with 4no. connected commercial office buildings which are proposed to be demolished and replaced with 2no. blocks of 11-14 storey commercial office buildings with associated car parking and limited landscaping areas.

The remediation strategy is required in conjunction with the following Planning Application and Manchester City Council outline planning conditions:

- Planning Ref: Application No: CDN/23/0775 - Discharge of condition 4b (Contaminated Land) - 1 City Road East

1.2 Previous Surveys

NX Consulting have carried out previous surveys at the site.

- 'Phase 1 Geoenvironmental Desk Study on Land at One City Road, Manchester, M15 4PN' by NX Consulting. Reference Ref: NX406/R1, dated August 2020.
- 'Geotechnical report – No 1 City Road, Manchester' by Arup, reference Report 18693/CRL/KSC, dated February 1993.
- Phase 1 Geoenvironmental Desk Study on Land at One City Road, Manchester, M15 4PN' by NX Consulting. Reference Ref: NX406/R1, dated August 2020

This Remediation Strategy Report should be read in conjunction with the report listed above.

1.3 Objectives

Guidance set out in LCRM1, GPLC1-32 and the National Planning Policy Framework (NPPF)³ provides guidance on how to develop a remediation strategy, implement it and verify that any remediation has worked. The aims of the Site Investigation and Remediation Strategy are as follows:

- To investigate the contaminant status of the shallow soils beneath the site.
- To investigate the ground gas regime beneath the site.
- To comply with the requirements of the Local Planning Authority (Manchester City Council) and their Environmental Health Department/Pollution Control Unit to ensure that future end users of the site are not put at risk from any chemical contamination arising from its former uses.
- To ensure that construction workers are not put at an unacceptable short-term risk in reclaiming/remediating and redeveloping the site.
- To satisfy the requirements of the Environment Agency in ensuring that the proposed construction works provide a degree of protection necessary to controlled waters.

¹ EA (2020). "Land contamination risk management (LCRM).

² EA (2016). "Guiding Principles for Land Contamination." GPLC1-3.

³ DCL (2021). "National Planning Policy Framework." Department of Communities and Local Government.

1.4 Report Layout

Section 2 of this report provides background information with respect of the site such as site setting and description.

Section 3 details the intrusive investigations carried out to date with a summary of the environmental setting, ground conditions and chemical analyses.

Section 4 details the ground gas risk assessment and target concentrations at the site.

Section 5 details the geochemical risk assessment and target concentrations at the site.

Section 6 presents the remedial strategy for the site and section 7 discusses the requirements for subsequent development at the site.

1.5 Limitations

The accuracy of the data supplied by third parties should be considered in the context of any known site conditions for which NX Consulting Limited cannot be held liable.

The comments given in this report and the opinions expressed assume that the ground conditions (geology, hydrogeology, contamination) do not vary beyond the range revealed by this assessment. There may be, however, conditions within the site, which have not been identified from the information reviewed and consequently have not been considered in this report: confirmation of such uncertainties should be the focus of any future intrusive investigations.

The comments made in this report are based on the data available at the time of its completion. Any unusual or conflicting evidence discovered during any future site works must be presented to NX Consulting as soon as possible so that any implications may be considered.

This report is provided for the benefit only of the party to whom it is addressed. NX Consulting does not extend responsibility to any third party for the whole or any part of the contents. NX Consulting owes no duty of care in relation to this report to any third party. The investigation and reportage has been undertaken with all reasonable skill, care and due diligence. NX Consulting disclaims any responsibility to the client or others in respect of any matter(s) outside this agreed scope of the above works.

In addition to the above it should be noted that when investigating or developing land, sub-surface conditions might vary both spatially and over time. Whilst this investigation and subsequent interpretation has been undertaken to reasonably characterise current sub-surface conditions at the site within the scope of works and agreed budget, the absence of certain ground, contamination or groundwater conditions at the individual locations is not a guarantee that these conditions do not exist elsewhere on the site. Additional information, changes in legislation or revised practices may necessitate re-interpretation of part or all of this report.

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2.0 BACKGROUND

2.1 Site Location & Setting

The property is approximately 0.55 hectares in size and located on land at No. 1 City Road East, Manchester, M15 4PN. National grid reference (NGR: E383596, N397324.). A site location plan is presented in Appendix A.

The site is located within a predominately commercial area, bounded by Medlock Street to the east, City Road E to the north, Shortcroft Street to the west and River Street to the south with a multi-storey hotel building beyond (Premier Inn).

The site is irregular in shape and currently comprises a derelict former office building in the east, a car park within the western site area and raised landscaping beds are present along the site boundary.

2.2 The Proposed Development

It is understood that the site is currently developed with 4no. connected commercial office buildings which are proposed to be demolished and replaced with 2no. blocks of 11-14 storey commercial office buildings with associated car parking and limited landscaping areas.

A site layout is presented on drawings in Appendix A.

2.3 Environmental Setting

A summary of the environmental setting of the site pertinent to this report has been summarised below.

Table 2.2 – Summary of Geology Hydrology and Hydrogeology	
Drift Geology	BGS Sheet 85 'Manchester', Bedrock and Superficial, 1:50,000 dated 2011 indicates that Glaciofluvial Sheet Deposits (Sand and Gravel) are present on site and are expected to be present beneath the entire site.
Solid Geology	<p>BGS sheet 85 'Manchester', Solid and Drift Geology, 1:50,000 dated 2010 indicates that sandstone of the Chester Formation (Triassic in age) underlies the site.</p> <p>The Groundsure report indicates that there are a number of boreholes held by the BGS which are publicly available.</p> <p>The nearest available BGS borehole log is located approximately 29m to the north (ref SJ89NW118) and indicated sandstone to be present at depths of 7.01m bgl to a proven depth of 11.28m bgl.</p>

Table 2.2 – Summary of Geology Hydrology and Hydrogeology

Hydrology	<p>The nearest surface watercourse to the site is the River Medlock, located 12m to the north of the site.</p> <p>The River Catchment (Lumb Brook to River Irwell) has an overall EA rating of moderate. The ecological rating is Moderate. The chemical rating is Good.</p>
Hydrogeology	<p>Drift - Secondary A Aquifer (permeable layers capable of supporting water supplies at a local rather than strategic scale).</p> <p>Bedrock deposits – Chester Formation strata underlying the site are a Principal Aquifer (geology of high intergranular and/or fracture permeability, usually providing high levels of water storage).</p> <p>Groundwater was monitored at depths between 2.73m and 5.34m bgl during ground gas and groundwater monitoring.</p>
Water Abstractions	<p>Several groundwater abstractions have been identified within 1000m. The closest abstractions are summarised as follows:</p> <ul style="list-style-type: none"> • 2 no. licenses at Manchester Metropolitan University, 506m south. Licensed to abstract 274,115m³ per day for general use and heat pump. • 2 no. licenses at Lower Chatham Street, 55m east. Licensed to abstract 283,240m³ per day for general use and heat pump. <p>No surface water or potable abstractions are recorded within 1km of the site.</p>
Source Protection Zone	<p>The site does not lie within a currently defined Groundwater Source Protection Zone.</p>

Site History

The site has formerly been in use as a cluster of buildings, including a saw mill, a timber yard and a factory.

1848 mapping shows the site to be occupied by a cluster of buildings in the central-eastern and southern site areas. The southern site area is divided by Glass Street running south-west to north-east.

Around 1908, the site comprises a Sawmill across the majority of the site with multiple buildings.

1948 mapping shows the southern site area to have been replaced by a Timber Yard. The Arup report highlights that 1953 photographs shows the addition of a 'factory' in the west with chimneys/incinerators in the north and south of the building respectively.

C. 1986 The Sawmill buildings have been demolished and replaced by a car park. The is shown to be cleared c. 1990, and the current existing buildings are recorded c. 1992 with a car park in the west of the site.

Coal Authority

The site lies within the Coal Authorities Coal Mining reporting Area. However, NX Consulting considers that the risk of underground coal mining to be low based upon the extensive cover of sandstone beneath the site.

Underground Services and Tunnels

Underground services are likely impact the site and the design team should familiarise themselves with their presence and implications on the development.

The Guardian Underground Telephone Exchange (GUTE) also known as 'Scheme 567' is a 1950s nuclear-hardened facility designed to safeguard cold war communications. The tunnel is still present beneath ground level beneath certain areas of Manchester, but is not within proximity of the site (<https://hidden-manchester.org.uk/#/gute/guardian-underground-telephone-exchange>).

Culverted Watercourses

Medlock Gaythorn Culvert

This culverted section of the River Medlock flows under the First Street development, formerly the Gaythorn Gasworks. On *1845 OS Six-Inch map* it is shown as an open river, and by 1888 it had been covered as shown on the *Lancashire. Manchester. Sheet CIV. 10. 14* map. It is recorded to still be following its original course at this point (shown dashed on this map), and the route appears to have been straightened at some point circa 1888. Within this section the hidden River Tib meets the River Medlock.

The proximity of culverted features and the River Medlock to the site can be viewed on the link to the interactive map below.
(<https://hidden-manchester.org.uk/#/gute/guardian-underground-telephone-exchange>).

It is also likely that during the redevelopment of the Gaythorn Gas Works that the culverted watercourse was excavated.

3.0 GROUND INVESTIGATION

3.1 Fieldworks

An intrusive investigation was carried out in two phases by Taylor Drilling Services Ltd and monitored by an engineer from NX Consulting.

The preliminary phase of fieldworks were undertaken between 11th July 2023 and 17th July 2023.

The first phase of supplementary works were carried out on 25th & 27th July 2023. These works were designed to further investigate the drift deposits using Cable Percussive Drilling, specially relating to the Glacial Sand and Gravel. Due to limitations with access and stabilizing the WS rig within internal areas of site, not all works were able to be completed during the first phase of works. Therefore, a second phase of supplementary works were carried out on 3rd & 4th August 2023. These works comprised 5No. WS boreholes within the internal areas of the site.

For the simplicity of this report and due to all phases of works being completed within close proximity, the works will be summarised as a collective.

2no. Rotary Core boreholes (RBH01 and RBH02) were undertaken during the preliminary phase of fieldworks across the site to depths ranging from 21.00m bgl to 22.50m bgl.

7no. machine excavated trial pits were undertaken during the preliminary phase of fieldworks across the site to depths of between 2.00m bgl. and 3.10m bgl.

4no. cable tool boreholes were undertaken during the supplementary phase of fieldworks across the site to depths of between 5.26mbgl. and 7.00mbgl.

17no. windowless sample boreholes were formed during both phases of the site investigation to a maximum depth of 6.0mbgl.

Groundwater monitoring wells were installed in RBH01, RBH02, WS01, WS05, WS06, WS07, WS08, WS10, WS12, WS14a & WS15a, to a maximum depth of 5.00mbgl on completion. The response zones were kept within the Made Ground, Glacial Sand and Gravel, Clay, Alluvium, Sand, and comprised an upper 0.50m of plain pipe connected to a length of slotted pipe with a pea gravel surround. Groundwater was recorded between 3.0m and 3.5m bgl, within subsequent groundwater monitoring within these installations.

Surface soils samples were tested for a number of general screening tests including pH and metals, cyanide, phenols, sulphide, sulphur and speciated PAH, speciated TPH, BTEX and asbestos screening to confirm, or otherwise, the site's anticipated risk status.

3.2 Ground Conditions

Topsoil/Made Ground

Topsoil was not recorded within any supplementary exploratory hole locations.

Made Ground was recorded within all exploratory hole locations to maximum proven depths of 4.90m bgl (RBH01). An average thickness of approximately 2.50m has been recorded within NX boreholes. Deposits were noted to comprise sands and

gravels with a high content of cobbles and boulders which comprised bricks, concrete and general demolition backfill.

It is probable that when historical buildings on the site were demolished much of the material was backfilled on site and possibly into former cellars associated with the former buildings.

Superficial deposits

Superficial deposits were encountered within the majority of exploratory holes between depths of 0.25m to 7.50m bgl (WS10 to RBH01), with the exception of HP01, TP01, TP03, WS09, WS13, WS14 and WS15 where the Made Ground was not able to be fully penetrated.

Superficial deposits were noted to typically comprise an initial layer of Glacial Sand and Gravel was typically loose to medium dense light brown (occasionally yellow brown), subrounded to rounded gravel of mixed lithology to recorded maximum depths of 4.70mbgl.

Beneath the Glacial Sand and Gravel in all exploratory holes (and beneath the Made Ground where Glacial Sand and Gravel was not encountered), Glacial Till was present and was proven to a maximum depth of 6.0mbgl (WS01). The Glacial Till comprised brown typically firm to stiff clay (locally soft to firm), exhibiting a consistent trend of increasing stiffness with depth, and was frequently found to be stiff to very stiff between 3.00mbgl to 4.00mbgl.

Alluvial deposits were found in WS05 (3.65m – 5.0mbgl), WS11 (3.20m – 5.00m bgl), and BH01 (3.60m bgl to 6.50m bgl). These deposits included soft to firm grey-brown clayey silt and/or loose to medium dense light grey silty clayey sand. Some areas also contained soft silty clay, fine gravel, peat laminations and layers of with sand and gravel.

Probable Glaciofluvial drift deposits comprising dense red/brown SAND AND GRAVEL (drillers description) was found beneath clay within all rotary boreholes, between 4.5mbgl and 7.5mbgl; and similar strata was recovered within the Cable Tool boreholes and was logged as HIGHLY WEATHERED SANDSTONE and WEATHERED SANDSTONE; recovered as dense to very dense gravelly sand/sandy gravel within CP01 to CP04 between 5.0m to 7.0mbgl.

Uncorrected SPT 'N' values ranged from 1-50, with an average 'N' value of 22.6 and generally increased with depth.

Bedrock deposits

Solid geology was encountered within both of the 2no. rotary core boreholes at depths between 6.00-22.50mbgl and noted to comprise weak to medium strong reddish brown fine to coarse grained SANDSTONE with rare mineral inclusions and intraclasts. Subhorizontal bedding fractures, thinly spaced, planar, smooth to slightly rough were also noted upon recovered core runs.

Recovery was often poor within 5.00m and 7.00m were the rock being poorly cemented. This generally improved as drilling progressed. Irregular bands of marl were observed between 7.00m and 9.00mbgl within RBH02, and at 13.50mbgl within RBH01. The marl appeared medium brown in colour. The colour of the sandstone generally remained reddish brown throughout, with some areas appearing light brown in colour.

Natural fractures in the bedrock were documented within the core samples, whereas fractures resulting from the drilling process (drilling induced fractures) were excluded from the calculations for the fracture index.

3.3 Groundwater

Table 3.3 below highlights recorded depths of groundwater strikes within 2No. window sampler boreholes at depths of between 3.00 & 3.50mbgl. It should be noted that water added to aid drilling, may have masked the presence of groundwater strikes.

Groundwater level monitoring has recorded no significant groundwater over a six-week period to date.

Table 3.3 – Groundwater Observations within During Trial Pitting Works

Location	Depth (m)	Strata	Comments
WS05	3.5	MG	Moderate ground water ingress within MADE GROUND.
WS16	3.0	CLAY	Low ground water ingress perched above natural CLAY deposits.

The shallow groundwater deposits within the Made Ground deposits appears to be discontinued and perched upon the Alluvium/Glacial Clay. An absence of groundwater strikes and limited available nearby borehole logs has restricted regional groundwater flow calculations. It is anticipated to flow to the west/northwest towards the River Medlock.

3.4 Underground Service Plans

Underground services, BT Lines, gas mains, combined and foul sewers, CCTV and possible fibre optic cables may all impact the site and the design team and Client should familiarise themselves with their presence. A culverted watercourse is also located in the centre of the site, flowing north to south.

3.5 Below ground obstructions

It is considered probable that relic infrastructure associated with demolition of former buildings and in-situ relic infrastructure (roads etc) is likely to still remain beneath the site. The areas of which can be establish from historical mapping in Appendix C of the NX supplementary report.

Several exploratory holes noted the presence of concrete and brick cobbles and boulder obstructions within Made Ground. Namely: TP01, TP02, TP03, TP04, TP07, WS06, WS13 and WS14a

WS09 was excavated to 0.95mbgl where a solid obstruction was identified at the base of the hand pit. The hole was relocated to WS09a and no further obstructions were encountered.

TP02, TP04 and TP07 uncovered relic in-situ brick walls beneath the subbase during their excavation.

Obstructions in the form of unknown solid obstructions and cobbles, within internal exploratory holes were recorded within HP02, WS13, WS14 & WS15.

3.6 Contaminant observations

No hydrocarbon contamination observations were recorded during the site investigation.

All arisings from the first phase of the Ground Investigation were screened on-site for the presence of volatile organic compounds (VOC) using a MiniRae Photoionisation Detector (PID). No elevated concentrations (above 0.1ppm) were recorded.

4.0 CONTAMINATION ANALYSIS AND ASSESSMENT

The chemistry analysis results, presented in Appendix C of the NX site investigation were compared against the Tier 1 criteria for a *commercial* end use to reflect the development proposals.

The environmental chemistry results together with the findings of the preliminary intrusive investigation to date are consistent with the site's historical uses.

The following Tier 1 exceedances were recorded in the following 3no. exploratory holes during chemical analysis of site soils:

- Lead – WS06 @ 1.50m
- Asbestos – HP02 @ 0.40m
- Naphthalene – WS13 @ 1.40m
- Benzo(a)anthracene – WS13 @ 1.40m
- Chrysene – WS13 @ 1.40m
- Benzo(b)fluoranthene – WS13 @ 1.40m
- Indeno(1,2,3-cd)pyrene – WS13 @ 1.40m
- Dibenz(a,h)anthracene – WS13 @ 1.40m

No visual or olfactory evidence of hydrocarbon or solvent contamination was encountered during the NX Consulting investigation and chemical analysis of the soils proved no significant organic contaminants to be present beneath the site.

Given the nature of the contamination the most cost effective remedial solution is likely to comprise a simple capping layer.

Within areas of proposed landscaping, it is recommended that a minimum of 600mm of Made Ground (below proposed formation level), should be removed from site and replaced with clean inert materials to form a capping layer over any potential contamination.

Where site levels allow, it may be possible to retain the Made Ground on site and provide the 600mm capping layer above.

Where the Made Ground materials are less than 600mm thick, only the Made Ground materials will require removal.

In areas of the site where buildings and hardstanding are proposed the Made Ground can be left in-situ as the buildings and hardstanding areas will break the 'pollutant linkage' and remove the pathway for contamination and come in to contact with the end users.

Within areas of landscaping and P.O.S it is recommended that a minimum 600mm 'clean' cover system should be adopted.

Cover system depths and sample ratios should be carried out in line with Section 6 of Manchester City Council's Planning and Technical Guidance document relating to ground contamination, dated February 2021.

Site workers involved in excavations for foundations, roads, sewers etc during the construction works may come into direct contact with the soils containing slightly elevated concentrations of inorganic and organic contaminants and asbestos. We would therefore recommend that simple precautionary measures be adopted during the construction phase i.e. good personal hygiene, provision of suitable welfare facilities and basic personnel protective equipment.

Any areas of proposed landscaping will require imported subsoil/topsoil materials which will require chemical validation to demonstrate that they are suitable for a commercial end use and taken to depths sufficient to provide a sufficient cover system for all proposed materials used which are capable to support root growth.

All Asbestos Containing Material (ACM) identified during the site enabling works must be dealt with in strict accordance with the Control of Asbestos Regulations (CAR) 2012, UK Waste Management Legislation and the Environmental Protection Act 1994.

As a contingency measure and to protect construction workers and future end users from any asbestos contamination, we recommend (as a minimum) that the following protective measures are adopted during the proposed ground preparatory works:

- All site personnel should be provided with PPE when excavations and demolition works are taking place.
- A water bowser or other dust suppression equipment shall be provided in order to dampen exposed surfaces; during the movement of plant and removal of arisings.

Should off-site disposal be required, then additional asbestos quantification and waste classification testing should be undertaken to ensure that it is classified correctly and disposed at a suitably licenced facility.

All ACM impacted soils must be managed so as to ensure no airborne fibre release during construction or placement of impacted material in such a manner to ensure no future exposure risk.

Site soils will need to be placed below a suitable clean cover layer to ensure they pose no unacceptable risk to the future site users. Given the nature of the contamination the most cost effective remedial solution is likely to comprise a simple capping layer.

All operations will be subject to regulation using a 'Materials Management Plan' (MMP) to be created in accordance with Version 2 of the CL:AIRE Definition of Waste – Industry Code of Practice. The MMP should be created with due consideration to all proposed remediation and enabling works operations prescribed within this document and should be undertaken by a Qualified Person and a signed declaration submitted to the EA prior to re-use of materials on the site.

Topsoil should be in line with BS 3882: 2015 'Specification for topsoil' within the clean cover system.

Risks to Controlled Water Receptors

The proposed development area will comprise majority building and hardstanding cover which will restrict vertical and lateral percolation to the underlying aquifer and any surface water features. The Groundsure report indicates that nearest surface water features is the River Medlock situated 12m north of the site. Both site and regional groundwater flow is anticipated to be to the north and northwest towards the River Medlock.

Given the low mobility of recorded contaminants, the potential for the contaminants to represent suspended solids and development proposals comprising predominantly hardstanding impermeable surfaces reducing infiltration the risks to controlled water receptors post construction is deemed to be low.

As such the risks to controlled water receptors post construction is deemed to be low.

If contamination is found during construction works the associated risks should be reassessed.

4.1 Water Supply

Soil results were compared to the threshold limits published by UKWIR to determine the potential for contaminant ingress into existing water supply pipes, if these pipes are of plastic construction.

The results indicate that specialist protection measures are required in relation to the water supply pipework. A UKWIR risk assessment is recommended to be completed at the depth of the proposed pipes are likely to be required. It is anticipated that specialist water supply pipework will be required for all 'new' buildings. Additional testing may be required once the line of any new pipework is established.

4.2 Phytotoxicity

Phytotoxicity Guidance on the effects of metal contamination on plant growth is provided within the Ministry of Agriculture, Fisheries and Food (MAFF) Code of Good Agricultural Practice for the Protection of Soil.

Thresholds have not been exceeded within all samples analysed within the made-ground or natural soils with respect to the end use of the site.

4.3 Development Constraints

The potential risks which may exist on the site should be readily managed through implementation of an inspection regime to reduce uncertainty in the site conceptual model, good materials management and some basic mitigation measures to break the potential exposure pathways identified.

A significant amount of work will also be required to physically prepare the site for development and achieve the required stable development platform needed for the proposed buildings, car parking, access roads and supporting infrastructure. As this involves significant levels of site disturbance and importation of materials and soils for cover systems, the potential for introduction of new sources or creation of new pathways must be addressed.

The majority of the site is underlain by significant thicknesses of made ground comprising loose to medium dense granular deposits, cohesive deposits and numerous cobbles and boulder inclusions of concrete, brick masonry, industrial wastes, extending to depths of circa 4.90m bgl. Several obstructions and/or oversized

materials were encountered within the Made Ground with the potential for further features also present.

The following is a summary of the development constraints/conditions identified during the NX Consulting report, regarding to the proposed redevelopment of the site:

- Compliance with the requirements of the regulators i.e. Manchester City Council, the Environment Agency, service providers (e.g drainage, water, gas and electricity, fibre optics).
- The presence of existing foundations/slabs from previous site demolition and below ground obstructions and voids (buried structures, filled cellars, demolition wastes, etc).
- The presence of a significant thickness of Made Ground across the site.
- Active (Particularly the gas main) and relic site services not identified to date.
- Ground Gas Protection Measures are not required for proposed buildings, based upon gas monitoring to date.
- Placement of clean cover systems in line with Section 6 of Manchester City Council's Planning and Technical Guidance document relating to ground contamination, dated February 2021.

5.0 GROUND GAS PROTECTION

Recommendations & Gas Protection Design

In line with CIRIA 665 Guidance on Methane and Carbon Dioxide, the site is to be developed for commercial end use and the ground gas investigation has identified a maximum carbon dioxide concentration of 5.70% with maximum flows recorded to 0.1/hr. The maximum-recorded concentration for methane was 12.6%.

GSV values fall into Characteristic Situations 2 and gas protection measures should be installed beneath all buildings in accordance with BS8485: 2015. Based on a Type C development and CS2 classification and a ground gas protection score of 2.5 to would need to be achieved as highlighted within Table 8.6.2 below.

Table 8.6.2 Gas Protection – No.1 City Road East, Manchester

Building Type	Floor Slab Type	Ventilation	Available Points Score
C	Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended.	Full reinforced gas proof membrane installed to BS8485:2015 and validated to CIRIA 735, and passively vented underfloor sub-space.	3.5 to 6

Gas protection measures should be installed as prescribed in BRE 414 with the ventilation of the sub-floor void designed to provide a minimum of one complete volume change per 24 hours. Independent validation of gas protection measures is needed to achieve the required points score.

NX have been provided with detailed drawings by Booth King Partnership which are available in Appendix A of this document. Typical service entry details from manufacturers are also provided within Appendix A.

Soil testing to date indicates that there is a low risk of vapour generation and migration into the proposed buildings. No specific protection measures are envisaged in relation to hydrocarbon contamination. A watching brief should be carried out on site and if solvent/hydrocarbon contamination recorded then NX should be notified and further testing carried out to establish potential risks.

The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level. No radon protective measures are necessary.

Verification will be required as set out in Section 7 of this document.

6.0 REMEDIATION STRATEGY

6.1 Aims

The aims of this remediation strategy are the following:

- Resolve any potential and identified contamination issues in order to protect environmental receptors, and render the site suitable for the proposed development.
- Satisfy the Environmental Agency and the Local Planning Authority with regards to any unidentified soil and groundwater contamination.
- Provide a stable development platform (to agreed levels and gradients) for subsequent construction of the proposed development and associated infrastructure.

6.2 Recorded Contamination

Chemical sampling of site soils, to date, indicate that the site soils are potentially unsuitable for use within gardens and landscaping due to potentially unacceptable levels/presence of asbestos and Tier 1 exceedances of:

- Lead
- Naphthalene
- Benzo(a)anthracene
- Chrysene
- Benzo(b)fluoranthene
- Indeno(1,2,3-cd)pyrene
- Dibenzo(a,h)anthracene

As such remedial measures are recommended with respect to commercial landscaping and areas of public open space (P.O.S).

As Asbestos Containing Material (ACM) was found during soil sampling of made ground, given the age and nature of demolition arisings, further presence cannot be discounted. As a contingency measure and to protect construction workers and adjacent receptors from any unidentified asbestos contamination, we recommend that any identified ACM, found during the site enabling works should be dealt with in strict accordance with the Control of Asbestos Regulations (CAR) 2012, UK Waste Management Legislation and the Environmental Protection Act 1994. The following protective measures should be adopted (Site Wide) during the proposed ground preparatory works:

- All site personnel should be provided with PPE.
- A water bowser or other dust suppression equipment should be provided in order to dampen exposed surfaces; during the movement of plant and removal of arisings.

6.3 Proposed Remedial Measures & Material Management Plan Requirement

Given the nature of the contamination the most cost effective remedial solution is likely to comprise a simple capping layer.

Within areas of proposed areas of P.O.S and landscaping it is recommended that a minimum of 600mm of Made Ground (below proposed formation level), should be removed from site and replaced with clean inert materials to form a capping layer over any potential contamination.

Where site levels allow, it may be possible to retain the Made Ground on site and provide the 600mm capping layer above.

Where the made ground materials are less than 600mm thick, only the Made Ground materials will require removal.

In areas of the site where buildings and hardstanding are proposed the made ground can be left in-situ as the buildings and hardstanding areas will break the 'pollutant linkage' and remove the pathway for contamination and come in to contact with the end users.

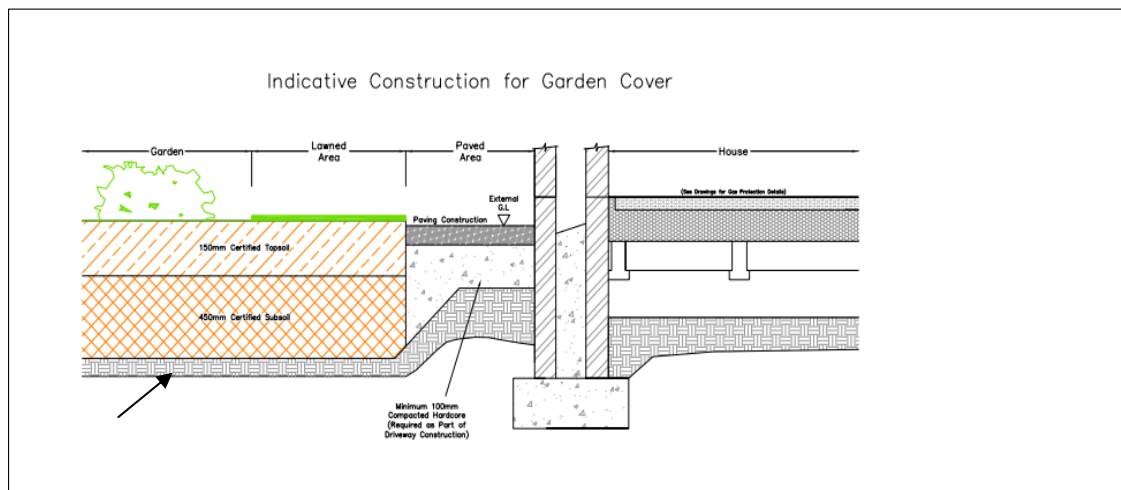


Figure 6.3.1 – Clean Cover System Example

Best practice typically states that the 'clean cover system' layer should comprise a capillary break layer/hard to dig layer comprising 100mm of compacted stone or geotextile membrane beneath the 450mm of clean imported subsoil and 150mm of topsoil to form the 600mm the cover system thickness. Given the nature of recorded contamination and commercial end use development, we consider that hard to dig layers are not required in landscaped areas. However, future contractors should be notified to ensure that appropriate PPE is adopted when future excavation works are carried out within proposed landscaped areas.

Materials imported to site are required to be suitable for the intended commercial purpose.

Construction operations may be subject to regulation using a 'Materials Management Plan' (MMP) to be created in accordance with Version 2 of the CL:AIRE Definition of Waste – Industry Code of Practice. If so, the MMP should be created with due consideration to all proposed remediation and enabling works operations prescribed

within this document and should be undertaken by a Qualified Person and a signed declaration submitted to the EA prior to re-use of materials on the site.

Topsoil should be in line with BS 3882: 2015 'Specification for topsoil' above the break subsoils and/or breaker layer.

At the site boundaries care should be taken not to undermine any existing structures or infrastructure. Where, such a risk may be present, it is recommended that any remedial excavations are battered back at a suitable angle (1:1). Given the relatively low levels of contaminants recorded and the very limited areas this is likely to entail any potential residual risk is likely to be very low.

6.4 Risk Assessment & Target Concentrations

Quantitative risk assessments have not been established to date to derive site specific clean up criteria for hydrocarbon contamination. This is because the results recorded to date for soils have been recorded generally below Environment Agency Soil Guideline Values (SGVs), Generic Assessment criteria and C4SIs. NX Consulting propose continued use of SGVs and GACs for a commercial end use throughout the remediation works. If deemed necessary as a result of the finding of the any unexpectedly elevated concentrations of hydrocarbon contamination, site-specific clean up criteria will be reassessed via human health QRA.

With regards to site specific clean up criteria for hydrocarbon contaminated Made Ground where encountered, remediation proposals include provision of a capping system and basic gas protection measures, thus breaking the source-pathway-receptor linkage. The NX Consulting conceptual model should be continually reassessed, throughout the construction works. As such, Tier 1 commercial values have been utilised at this time.

The following table provides Tier 1 values for a range of potential contaminants for the site; for a commercial end use.

	Residential with Homegrown Produce.	Residential without Homegrown Produce.	Commercial Industrial with Landscaping
Active Pathways	<ul style="list-style-type: none"> • Direct Ingestion • Dermal Contact • Consumption of Vegetables and Attached Soil • Inhalation of Indoor Vapour and Dust • Inhalation of Outdoor Vapours and Dust 	<ul style="list-style-type: none"> • Direct Ingestion • Dermal Contact • Inhalation of Indoor Vapour and Dust • Inhalation of Outdoor Vapours and Dust 	<ul style="list-style-type: none"> • Direct Ingestion • Dermal Contact • Inhalation of Indoor Vapour and Dust • Inhalation of Outdoor Vapours and Dust
Critical Receptors	Female Child 0-6yrs Old	Female Child 0-6yrs Old	Female Adult Worker >17 years old.

Determinand/Units	mg/kg	Source	mg/kg	Source	mg/kg	Source
Arsenic	37	LQM / CIEH S4ULs	40	LQM / CIEH S4ULs	640	LQM / CIEH S4ULs
Cadmium	11	LQM / CIEH S4ULs	85	LQM / CIEH S4ULs	190	LQM / CIEH S4ULs
Mercury (inorganic)	40	LQM / CIEH S4ULs	56	LQM / CIEH S4ULs	1,100	LQM / CIEH S4ULs
Nickel	180	LQM / CIEH S4ULs	180	LQM / CIEH S4ULs	980	LQM / CIEH S4ULs
Selenium	250	LQM / CIEH S4ULs	430	LQM / CIEH S4ULs	1,200	LQM / CIEH S4ULs
Chromium III	910	LQM / CIEH S4ULs	910	LQM / CIEH S4ULs	8,600	LQM / CIEH S4ULs
Chromium VI	6	LQM / CIEH S4ULs	6	LQM / CIEH S4ULs	33	LQM / CIEH S4ULs
Lead	450	C4SLs	450	C4SLs	750	C4SLs
Copper	2,400	LQM / CIEH S4ULs	7,100	LQM / CIEH S4ULs	68,000	LQM / CIEH S4ULs
Zinc	3,700	LQM / CIEH S4ULs	40,000	LQM / CIEH S4ULs	730,000	LQM / CIEH S4ULs
Boron	290	LQM / CIEH S4ULs	1100	LQM / CIEH S4ULs	240,000	LQM / CIEH S4ULs

Consulting Tier 1 Values Version 1 - CLEA 2009 (Software Version 1.06)

LQM /CIEH S4ULs Copyright Land Quality Management Limited. Reproduced with permission Publication No. S4UL3671. All right reserved.

Standard Land Use Scenario	Residential with Homegrown Produce			Residential without Homegrown Produce			Commercial			Source
Determinand/SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	
<i>Naphthalene</i>	2.3	5.6	13	2.3	5.6	13	190	460	1100	LQM / CIEH S4ULs
<i>Acenaphthylene</i>	170	420	920	2900	4600	6000	83000	97000	10000	LQM / CIEH S4ULs
<i>Acenaphthene</i>	210	510	1100	3000	4700	6000	84000	97000	10000	LQM / CIEH S4ULs
<i>Fluorene</i>	170	400	860	2800	3800	4500	63000	68000	71000	LQM / CIEH S4ULs
<i>Phenanthrene</i>	95	220	440	1300	1500	1500	22000	22000	23000	LQM / CIEH S4ULs
<i>Anthracene</i>	2400	5400	1100	31000	35000	37000	520000	540000	540000	LQM / CIEH S4ULs
<i>Fluoranthene</i>	280	560	890	1500	1600	1600	23000	23000	23000	LQM / CIEH S4ULs
<i>Pyrene</i>	620	1200	2000	3700	3800	3800	54000	54000	54000	LQM / CIEH S4ULs
<i>Benzo(a)anthracene</i>	7.2	11	13	11	14	15	170	170	180	LQM / CIEH S4ULs
<i>Chrysene</i>	15	22	27	30	31	32	350	350	350	LQM / CIEH S4ULs
<i>Benzo(b)fluoranthene</i>	2.6	3.3	3.7	3.9	4	4	44	44	44	LQM / CIEH S4ULs
<i>Benzo(k)fluoranthene</i>	77	93	100	110	110	110	1200	1200	1200	LQM / CIEH S4ULs
<i>Benzo(a)pyrene</i>	2.2	2.7	3	3.2	3.2	3.2	35	35	35	LQM / CIEH S4ULs
<i>Indeno(1,2,3-cd)pyrene</i>	27	36	41	45	46	46	500	510	510	LQM / CIEH S4ULs
<i>Dibenz(a,h)anthracene</i>	0.24	0.28	0.3	0.31	0.32	0.32	3.5	3.6	3.6	LQM / CIEH S4ULs
<i>Benzo(ghi)perylene</i>	320	340	350	360	360	360	3900	4000	4000	LQM / CIEH S4ULs
<i>Benzene</i>	0.087	0.17	0.37	0.38	0.7	1.4	27	47	90	LQM / CIEH S4ULs
<i>Toluene</i>	130	290	660	880	1900	3900	55,600	11000	18000	LQM / CIEH S4ULs
<i>Ethylbenzene</i>	47	110	260	83	190	440	5,700	13000	27000	LQM / CIEH S4ULs
<i>Xylenes</i>	56	130	310	79	180	430	5,900	14000	30000	LQM / CIEH S4ULs
<i>Aliphatic C5-C6</i>	42	78	160	42	78	160	3200	5900	12000	LQM / CIEH S4ULs

Standard Land Use Scenario	Residential with Homegrown Produce			Residential without Homegrown Produce			Commercial			Source
Aliphatic C6-C8	100	230	530	100	230	530	7800	17000	40000	LQM / CIEH S4ULs
Aliphatic C8-C10	27	65	150	27	65	150	2000	4800	11000	LQM / CIEH S4ULs
Aliphatic C10-C12	130	330	760	130	330	770	9700	23000	47000	LQM / CIEH S4ULs
Aliphatic C12-C16	1100	2400	4300	1100	2400	4400	59000	82000	90000	LQM / CIEH S4ULs
Aliphatic C16-C35	65000	92000	110000	65000	92000	110000	1600000	1700000	1800000	LQM / CIEH S4ULs
Aliphatic C35-44	65000	92000	110000	65000	92000	110000	1600000	1700000	1800000	LQM / CIEH S4ULs
Aromatic C5-C7	70	140	300	370	690	1400	26000	46000	860000	LQM / CIEH S4ULs
Aromatic C7-C8	130	290	660	860	1800	3900	56000	110000	180000	LQM / CIEH S4ULs
Aromatic C8-C10	34	83	190	47	110	270	3500	8100	17000	LQM / CIEH S4ULs
Aromatic C10-C12	74	180	380	250	590	1200	16000	28000	34000	LQM / CIEH S4ULs
Aromatic C12-C16	140	330	660	1800	2300	2500	36000	37000	38000	LQM / CIEH S4ULs
Aromatic C16-C21	260	540	930	1900	1900	1900	28000	28000	28000	LQM / CIEH S4ULs
Aromatic C21-C35	1100	1500	1700	1900	1900	1900	28000	28000	28000	LQM / CIEH S4ULs
Aromatic C35-C44	1100	1500	1700	1900	1900	1900	28000	28000	28000	LQM / CIEH S4ULs
Aromatic+aromatic EC>44-70	1600	1800	1900	1900	1900	1900	28000	28000	28000	LQM / CIEH S4ULs
Phenol	280	550	1100	750	1300	2300	760	1500	3200	LQM / CIEH S4ULs
Cyanide	527			527			1400			CLEA 2009

Standard Land Use Scenario	Residential with Homegrown Produce	Residential without Homegrown Produce	Commercial	Source
PCBs	1.7	1.8	1.8	CLEA 2009

6.5 Construction Workers & Asbestos Control Measures

As a contingency measure and to protect construction workers and adjacent receptors from any unidentified asbestos contamination, we recommend that the following protective measures are adopted during the proposed ground preparatory works:

- All site personnel should be provided with PPE when excavations are taking place.
- A water bowser or other dust suppression equipment shall be provided in order to dampen exposed surfaces; during the movement of plant and removal of arisings.

6.6 Control of Water

During the removal of below ground obstructions and the excavation through of the made ground, perched water may be encountered.

Groundwater shall be control in accordance with CIRIA report 113 "Control of Ground Water to Temporary Works".

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

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

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

6.7 Exported to Landfill

Any soils to be exported from site should be allocated an appropriate waste code, following the steps within Technical Guidance WM3: Waste Classification - Guidance on the classification and assessment of waste 2015.

The results appended to this document indicate that the samples tested are likely to be classified as NON-HAZARDOUS and HAZARDOUS WASTE. This should be confirmed by the appointed waste management contractor following submission of all available test results carried out at the site to date.

Any material exported from the 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 and Wales) Regulations 2005.

A transfer note should then 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 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.

All hazardous waste going for disposal at landfills must be classified according to the new European Waste Catalogue (EWC).

Contaminated soils are minor entries in the EWC. Waste contaminated soils may be classified as either hazardous or non-hazardous depending on the concentrations of "dangerous substance" in the waste soil. An assessment of the composition of the waste soil will therefore be undertaken to determine if it is hazardous waste.

The WAC set threshold concentrations for leachable components of the waste stream and landfill operators will have waste acceptance procedures in place to ensure that only compliant waste is landfilled. Most waste will need to be treated before it can be landfilled to reduce its quality and the hazard it presents. Leaching compliance testing will be required in accordance with BS EN 14899:2005.

6.8 Dust Control

The excavation of fill should not present a significant problem with regard to emission of dust during the excavations and transport. However, at all times during the excavation works, Best Practicable Means shall be employed to minimise dust and odour generation and their emission off site.

6.9 Previously Unidentified Contamination

Should any suspected contaminated materials other than those detailed in this and previous reports be encountered during the re-development, then it should be excavated and stockpiled on an impermeable material and sampled and tested for an appropriate range of determinants.

Once the laboratory analysis of the material is available an assessment should be undertaken to determine whether it can be retained on-site or whether it should be disposed off-site.

Depending on the nature of any such impact it may be necessary to undertake validation testing of the excavation in order to demonstrate that no such materials are left in-situ.

6.10 Controlled Waters

No pathways should be created which results in impact to the underlying aquifer or surface water features.

The risk to Controlled Water receptors from leaching and groundwater migration is deemed to be low.

6.11 Potential below Ground Obstructions

Obstructions were encountered within Made Ground during both scopes of works.

Several exploratory holes noted the presence of concrete and brick cobbles and boulder obstructions within Made Ground. Namely: TP01, TP02, TP03, TP04, TP07, WS06, WS13 and WS14a

WS09 was excavated to 0.95mbgl where a solid obstruction was identified at the base of the hand pit. The hole was relocated to WS09a and no further obstructions were encountered.

TP02, TP04 and TP07 uncovered relic in-situ brick walls beneath the subbase during their excavation.

Obstructions in the form of unknown solid obstructions and cobbles, within internal exploratory holes were recorded within HP02, WS13, WS14 & WS15.

Further obstructions in the form of relic foundations and infrastructure may be found on site during groundworks. Particularly within the areas of the former buildings.

It is recommended that these materials be 'grubbing out' and treatment (screening/crushing/segregation and reused (where appropriate) on site as part of the site preparation. Materials unsuitable for reuse on site will require removal from site to suitably licensed waste management facility.

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

Trial trenching is recommended prior to the adoption of the chosen foundations to establish Made Ground depths beneath the area of former buildings; in line with the NX Phase 2 Geoenvironmental Assessment report.

Any excavations should ensure that adjacent building foundations are not unduly stressed or undermined.

6.12 Site Setup, Organisation and Safety

It is recommended that site works should be supervised (when only deemed suitable by the contractor), by a suitably qualified Engineer, who will report to a Project Manager. Supervision may be part time for certain activities but must be full time if (in the unlikely event) any grossly contaminated soil/fill is identified during construction works.

Site cabins and welfare provisions should to be provided in accordance with the HSE Guidelines by the appointed contractor.

It is recommended that all personnel should undergo a site specific health and safety induction prior to commencement of work on site.

Works will be carried out with the proper regard to the following standards:

- Health and safety at work act 1974
- Management of Health and safety at work Regulations 1999
- Construction (Health, Safety and Welfare) Regulations 1994
- Construction (Head Protection) Regulations 1998
- Provision and Use of Work equipment Regulation 1998
- Lifting Operations and Lifting Equipment Regulations 1994
- Construction (design and management) Regulations 1994
- Health and Safety Executive "Protection of Workers and the general public during the redevelopment of Contaminated Land", HS(G)66, HMSO 1991
- The Control of Substances Hazardous to Health Regulations 1994
- Any successive legislation to the above

It is recommended that during the construction works, all personnel on site should comply with guidance provided in the Health and Safety Executive (HSE) document "Protection of Workers and the general public during the redevelopment of potentially Contaminated Land". In summary, the following should be provided by the appointed contractor:

- Protective clothing, footwear, glasses and gloves. (Personnel should be instructed in why and how they are to be used).
- Disposable coveralls should be provided where appropriate.
- Hand-washing, eye-washing and boot-washing facilities.
- Smoking shall be limited to designated areas.

6.13 Contractor's Responsibilities

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

- Satisfy requirements of the Client's contract documentation.
- Establish the boundaries of the site and the working areas
- Liaise with Local Authority regarding working hours, noise/dust/odour control, and protected trees.
- Liaise with the Local Water Company prior to any proposed discharge to local sewers.
- Provide and erect secure Herras-type fence to protect site and any remedial activities and discourage entrance by the general public.
- Provide the engineer with consignment notes and Waste management tip tickets and records

It is recommended that the Contractor satisfy the HSE with regards to all matters concerning health, safety and the welfare of personnel on site.

It is recommended that the contractor ensures that:

- Personnel, plant, materials and other equipment related to the contract are confined within the boundaries of the site.
- Good practise relating to personal hygiene are adopted.
- Suitable precautions are taken to prevent the spread of soil and debris onto public roads.
- Suitable precautions are implemented to prevent offsite migration of any found pollutants via airborne dust and vapours.
- Refuelling of mobile plant is undertaken in a designated area. Above ground fuel storage tanks shall comply with the requirements of the Pollution Prevention Guideline PPG2. A spill kit shall be kept adjacent to any fuel storage area.

6.14 Engineering Supervision

It is recommended that the engineer ensures that the requirements of the Remediation Strategy are complied with in a safe and orderly manner.

The responsibilities of the Engineer shall include but are not limited to the following:

- Advice on the correct handling of unidentified soils/groundwater and conditions encountered.
- Retrieval of soil and water samples from within any unidentified areas of contamination and the subsequent scheduling of appropriate laboratory analysis to enable validation of various aspects of the works, and to advise the project manager of progress and unforeseen occurrences.
- Liaise with statutory authorities as required.
- Liaise with Client as required.

When onsite, the Engineer will maintain a record of the works to include the following:

- Daily record sheets and summary of the day's activities.
- Date and weather conditions
- Test results

6.15 Health and Safety during Remediation of Unidentified Contamination

During construction works, it is recommended that the workforce adopts full HSE measures to ensure that the elevated concentrations of contaminants, established during construction works, requiring cover, treatment and/or removal are dealt with according to current guidelines and codes of practice. Suitably experienced and competent staff should be employed to carry out the on-site remediation.

It is recommended that site personnel are not permitted to enter unstable excavations, nor excavations in which contamination is present, nor unsupported excavations deeper than 1.2m, in accordance with standard HSE protocols. Standard air sampling and monitoring equipment should be used which emits an audible warning of the presence of any volatile gases and/or low oxygen atmospheres.

NX Consulting are not the Planning Supervisor for this scheme and therefore, a site pre-tender health and safety plan has yet to be made available and will not form part of this scope of works.

6.16 Drainage and Services Installations

It is recommended that statutory services are consulted at an early stage, with respect to the ground conditions within which they will lay services, in order to enable them to assess at an early state any protection measures required. This includes submission of a potable water risk assessment.

Once approved, the nature of water supply pipework should be submitted to Manchester City Council's Council Director of Planning prior to construction being commenced.

Underground services, comprising BT Lines, gas mains, culverted watercourse, combined and foul sewers, CCTV and possible fibre optic cables may all impact the site and the design team and Client should familiarise themselves with their presence.

All drainage installation will encounter Made Ground. Any suitable Made Ground arisings from drainage trenches etc, if not returned to the original excavation must be placed beneath proposed hard end-use areas of the site, placed beneath a cover of suitable thickness in landscaped areas, or disposed off-site adhering to the guidelines outlined above.

7.0 VERIFICATION SUMMARY

Clean Cover Systems

Validation samples will need to be collected from all materials to be imported onto site to facilitate the proposed residential development.

Soil samples destined for chemical analysis to be collected in appropriate sampling containers. All samples will subsequently be stored in cool boxes prior to submission to a suitably accredited laboratory for analysis.

Where materials are found to contain concentrations of potential contaminants at levels in excess of the site specific screening criteria (as detailed within Table 6.1), undertake further assessment and recommendations on the appropriate use for the material in question.

For any imported materials required to complete the cover soils, the frequency of testing to be undertaken shall be as given in the Manchester City Council Planning & Contaminated Land Technical Guidance document, Sampling Ratios for Cover Systems, dated February 2021. The sampling frequency for materials to be managed under the Remediation Strategy is presented within Table 7.0 below. Where less than the stated volumes are utilised a minimum of three samples will be taken from each material/soil source.

Table 7.0 Proposed Testing frequency and analysis.

Soil Source	Sampling Frequency*	Analysis suite
Imported Soils - Brownfield source, or unknown soil source	Residential Gardens: 1:50m ³	Standard metals/ metalloids (should include as a minimum As, Cd, Cr, Cr, VI, Cu, Hg, Ni, Pb, Se, Zn), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).
	Soft Landscaping: 1:150m ³	
	Other: 1:200m ³	
Remediated Soils	Residential Gardens: 1:100m ³	Standard metals/ metalloids (should include as a minimum As, Cd, Cr, Cr, VI, Cu, Hg, Ni, Pb, Se, Zn), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).
	Soft Landscaping: 1:150m ³	
	Other: 1:200m ³	
Imported Soils - Greenfield Source	Residential Gardens: 1:200m ³	Standard metals/ metalloids (should include as a minimum As, Cd, Cr, Cr, VI, Cu, Hg, Ni, Pb, Se, Zn), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic

	Soft Landscaping: 1:200m ³	carbon (TOC).
	Other: 1:200m ³	

Analysis suite subject to review of specific soil source.

For any soil imported and installed into cover systems, a minimum of 3no. samples should be retrieved and tested regardless of the source/soil used to confirm its chemical suitability. All testing shall be carried out at a UKAS and MCERTS accredited laboratory.

Should any analyte exceed the concentrations shown, then the soil should be considered unsuitable for use within the capping system. The re-use of site won natural soils within the clean growing medium will require careful control of excavation arisings and soil management during the development. Clean soils won on site, or imported, that are not immediately placed, should be stored in stockpiles at agreed locations and sealed, by 'blading', to reduce water ingress and softening.

Depth validation of the capping system will be required. The validation will comprise a hand dug pits, with photographic record and hand pit logs.

The Validation Report will include the following:

- A summary of the preparatory works undertaken and remediation strategy.
- Details of who carried out the respective remedial works.
- Details and justification of any changes from the original remediation strategy, including unforeseen ground conditions.
- Copies of any correspondence with Regulators relating to specific aspects of remedial works.
- Substantiating validation data included as follows:
 - Laboratory and in-situ test results.
 - Chemical test results
 - Representative plans depicting treated areas and any amendments to strategy as a result of finding further contamination (if necessary).
 - Photographic records
 - Waste management tip tickets and records

Ground Gas Verification

GSV values fall into Characteristic Situations 2 and gas protection measures should be installed beneath all buildings in accordance with BS8485: 2015. Based on a Type C development and CS2 classification and a ground gas protection score of 2.5 to would need to be achieved as highlighted within Table 8.6.2.

Gas protection measures should be installed as prescribed in BRE 414 with the ventilation of the sub-floor void designed to provide a minimum of one complete volume change per 24 hours. Independent validation of gas protection measures is needed to achieve the required points score.

Ground gas verification should be carried out in line with the following documents:

- Chartered Institute of Environmental Health (2008). The local authority guide to ground gas.
- CIRIA Report C665. CIRIA Report C735 (Good Practice on the Testing and Verification of Protection Systems for Buildings Against Hazardous Ground Gases) and ASTM Standards D4437
- BRE 414 and 212.
- BS8485 2015 and A1:2019 Guidelines.

NX have been provided with detailed drawings by Booth King Partnership which are available in Appendix A of this document. Typical service entry details from manufacturers are also provided within Appendix A.

NX should be employed to develop a final gas verification report and refined risk assessment to confirm the low risk status to identified receptors; post construction.

The Verification report should include the following:

- Site and development details.
- Summary of Gas Risk Assessment
- Details of who carried out installation.
- Details of who carried out verification.
- Description of protection measures installed with reference to method statements and drawings and manufacturers specification of the materials used.
- Details of the actual verification inspection/s.
- Supporting information, plans, photographs, drawings.
- Summary of verification data (completed proformas, inspection record sheets and non-conformance/corrective action record sheets)

NX should inspect the membrane and selected seams/penetration. Attention being paid to areas most likely to cause failure. For the NX inspections, the seams along the propriety membrane should be subjected to a visual inspection and pick test, if hot welded methods are adopted. Cold weld methods are adopted, the joints should be subjected to an air lance test (where practical).

During the inspections the protection measures should be installed to a good level of workmanship and observed to fully lap over the external brick work. Any sub floor venting mats should be observed to be installed in line with manufacturers and structural engineers details. Where necessary any external venting grids should be installed into the pin kerbs.

The final Validation Report will need to be submitted to the Local Authority for agreement, prior to building occupation.

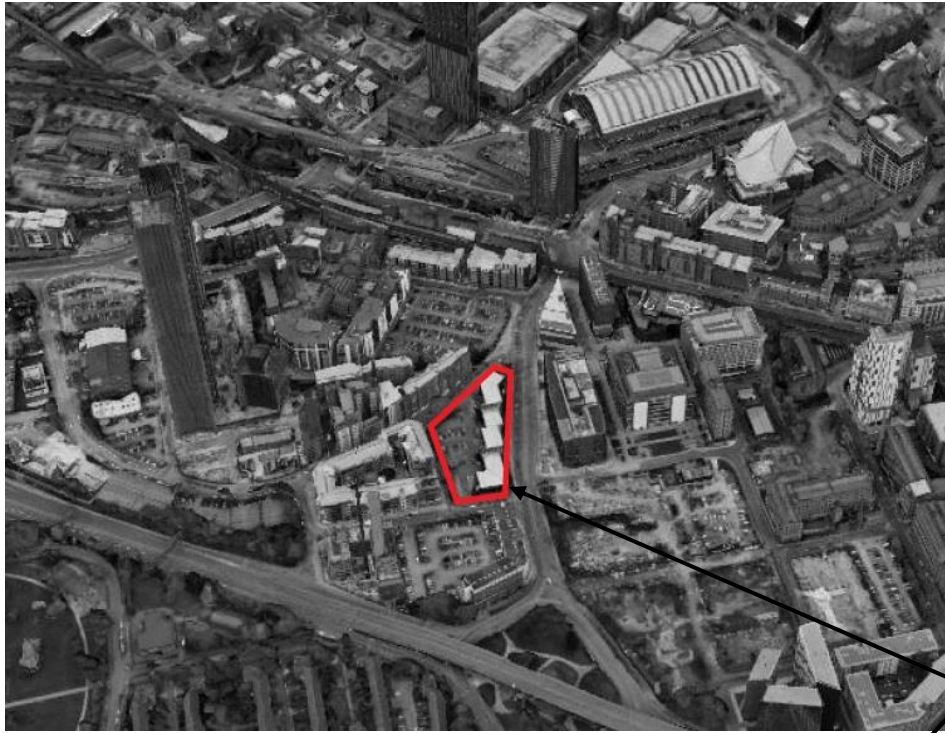
APPENDICES

Appendix A – Drawings

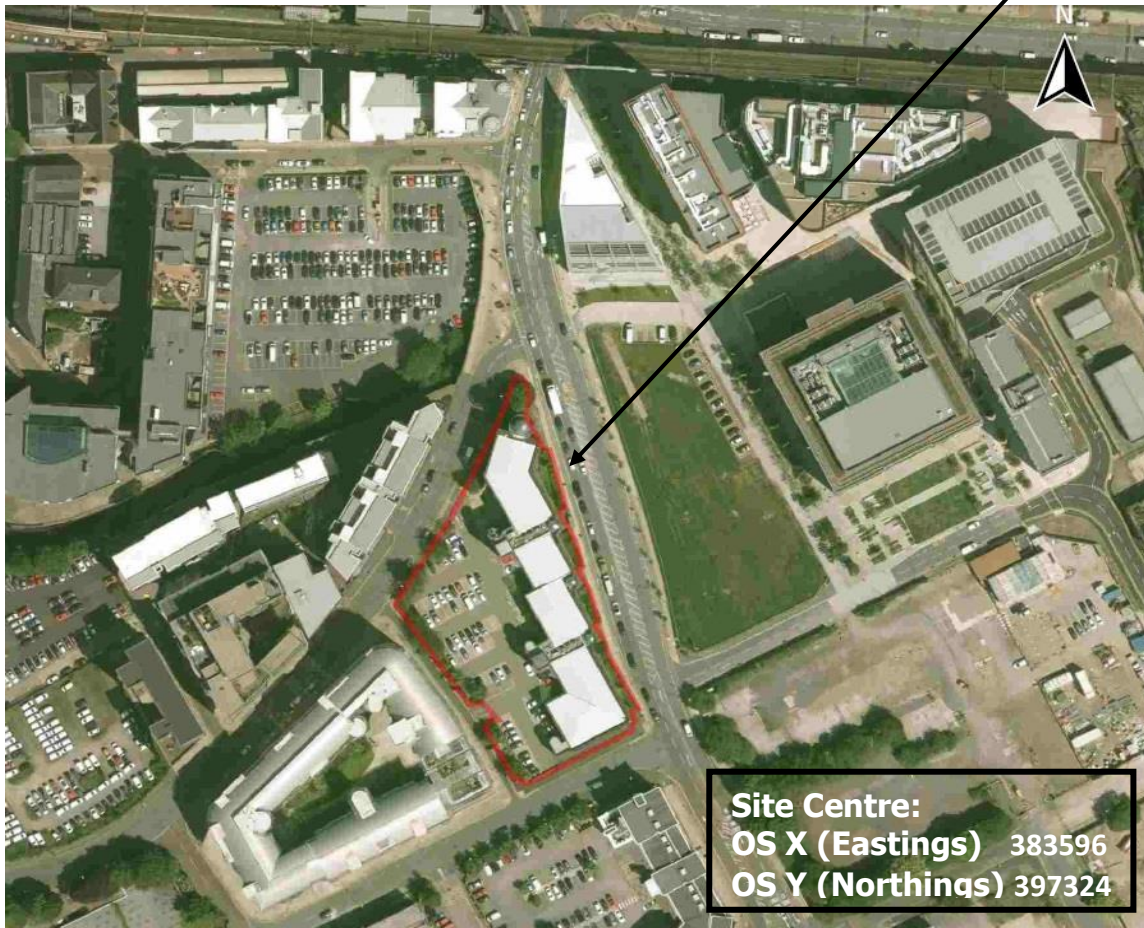
Appendix B – NX Consulting Protocol for Validation of Soil Cover Systems

Appendix C – Summary of Guidance Relating to Ground Gas

Appendix A – Drawings



**SITE
LOCATION**



Site Centre:
OS X (Eastings) 383596
OS Y (Northings) 397324



Next Generation Engineering Consultancy Services

Tel: 0161 904 0187
 E-mail: admin@nxconsulting.org.uk
 Web: www.nxconsulting.org.uk

Ref: NX406 Figure 1

Project:

One City Road, Manchester

Title:

Site Location Plan



Key	
	Approximate Site Boundary
	Denotes Significant Former Developments
	Denotes Subordinate Former Developments
	Denotes Former Roads
	Former Electricity Station
1	Former Gaythorn Gas Works
2	Former Dunlop Rubber Works
3	Former Engineering Works and Bus Depot
4	Former Works/Warehouse

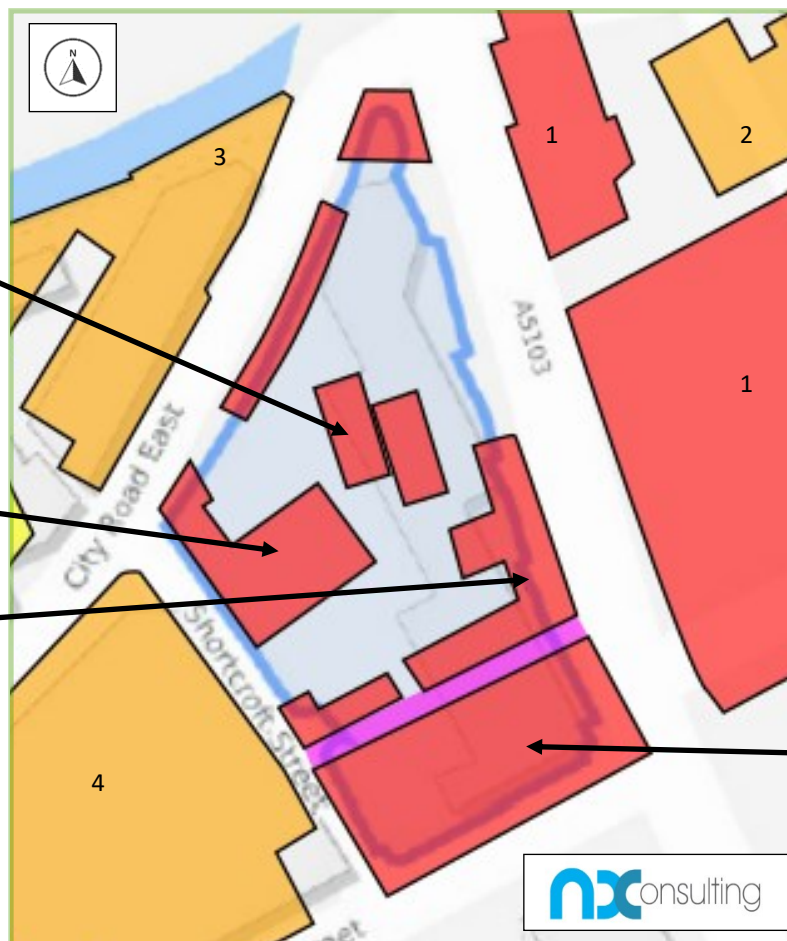
Ref: NX406 Figure 2 - Plate 1

Project:
No. 1 City Road, Manchester, M15 5PN

Title:
Conceptual Site Plan

Buildings associated to former Saw Mill development on site (northwards of former road).

Buildings associated to former Saw Mill hosting former incinerator/ chimney.



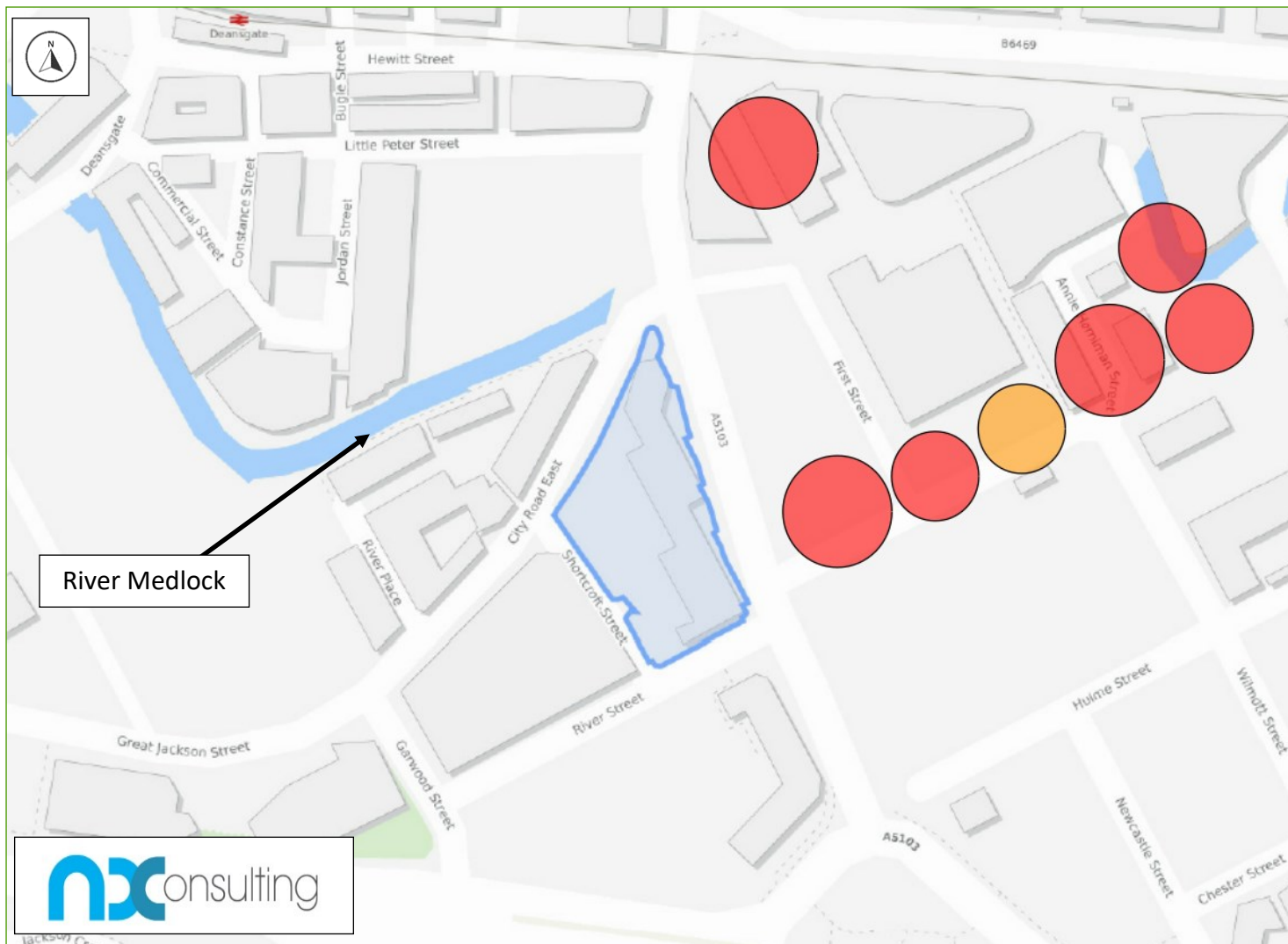
Buildings associated to former Timber Yard development within the southern area of the site.

Key	
	Approximate Site Boundary
	Denotes Significant Former Developments
	Denotes Subordinate Former Developments
	Denotes Former Roads
	Former Electricity Station
1	Former Gaythorn Gas Works
2	Former Dunlop Rubber Works
3	Former Engineering Works and Bus Depot
4	Former Works/ Warehouse

Ref: NX406 Figure 2 - Plate 2

Project:
No. 1 City Road, Manchester, M15 5PN

Title:
Conceptual Site Plan



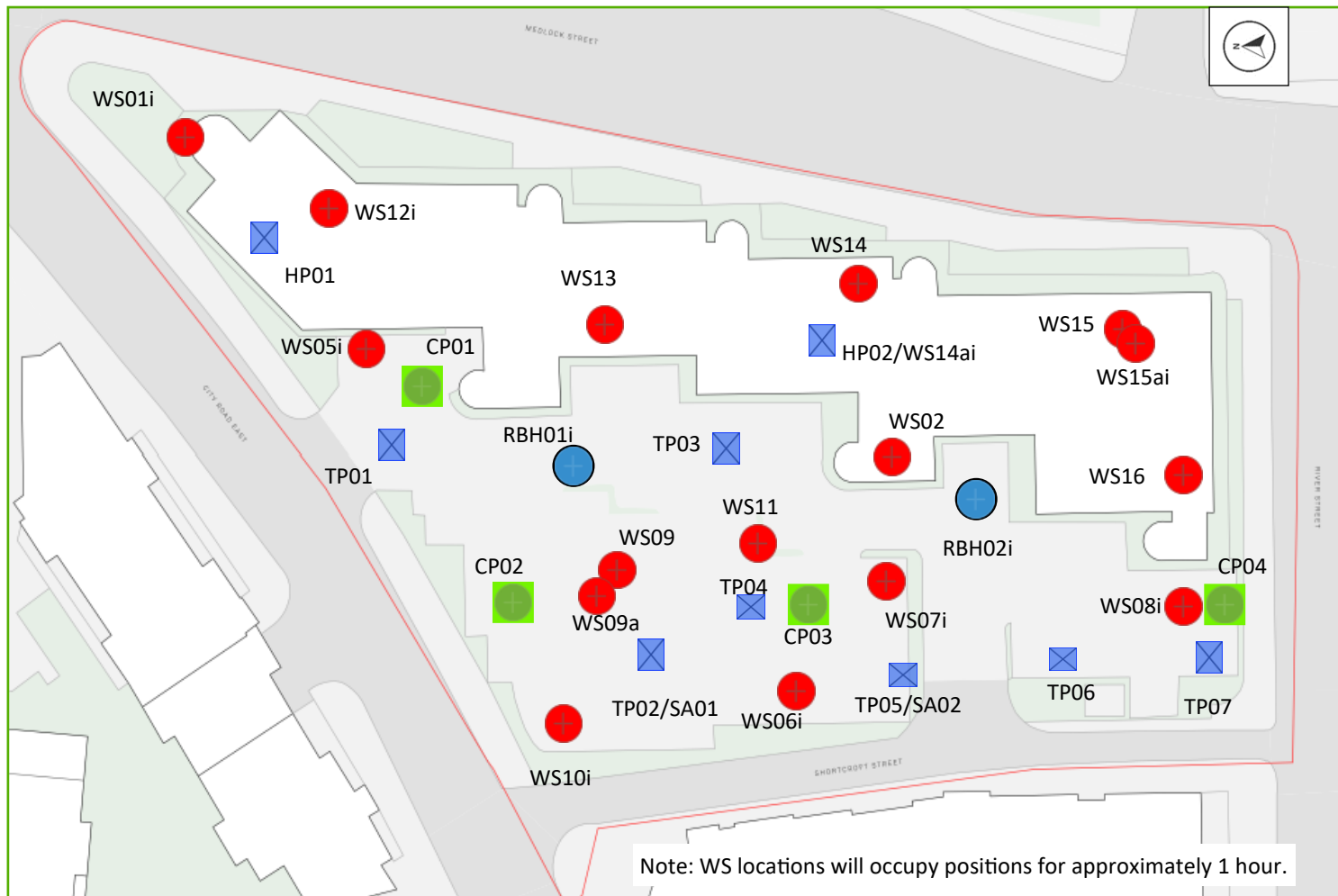
Key	
	Approximate Site Boundary
	Denotes Significant Former Gaythorn Gas Works Gas Cylinders
	Denotes Former Gaythorn Gas Works Tank

Gaythorn Gas Works initially appears on historical mapping in 1891. The five cylinders and the tank appear visible in 1893 mapping, and the large one to the north of site in 1908. Prior to the gas works the land previously accommodated: Finch Street Size Works, Street Dye Works and a Cotton Mill.

Ref: NX406 Figure 2 - Plate 3

Project:
No. 1 City Road, Manchester, M15 5PN

Title:
Conceptual Site Plan

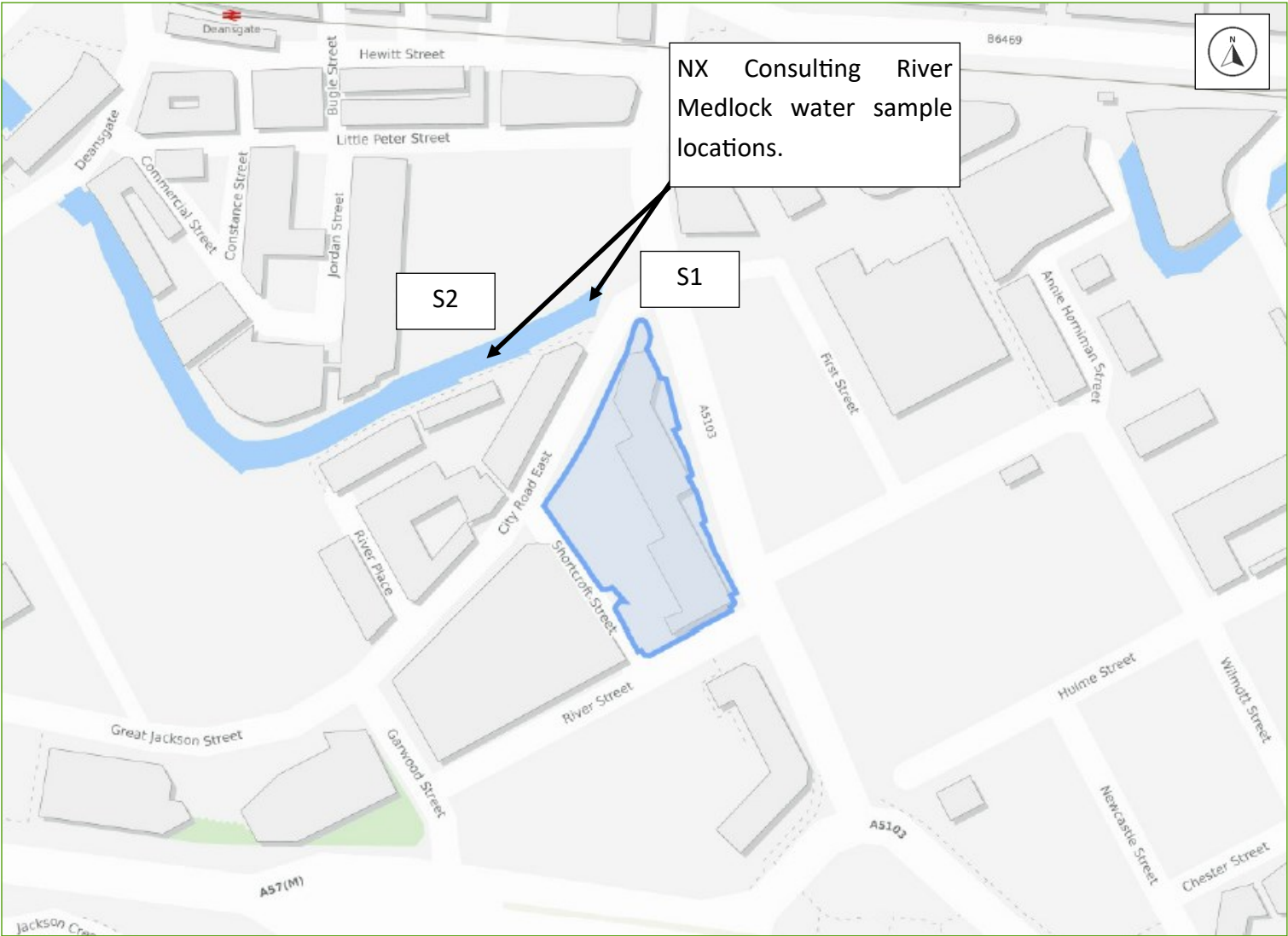


Key	
	Approximate Site Boundary
	NX Consulting Handheld Window Sampler Bore-holes (WS) to maximum depths of 6.45mbgl.
i	Denotes NX groundwa-ter/gas installation
	NX Machine Excavated Trial pit (TP)
	NX Manually Excavated Hand pit (HP)
	NX Consulting Rotary Core Boreholes, to maxi-mum depths 22.00m bgl (RBH)
	NX Consulting Cable Percussive Boreholes, to maximum depths 7.00m bgl (CP)

Due to the development history which has occurred on the site and surrounding area, NX Consulting will obtain upstream and downstream water samples of the River Medlock water at two sample locations.

The samples are to be taken to determine whether any potential contaminant migration from site to the nearby water course.

Proposed sample locations are to be taken from up and downstream for comparison purposes.



Ref: NX406 Figure 3 - Plate 2

Project:
No. 1 City Road, Manchester, M15 4PN

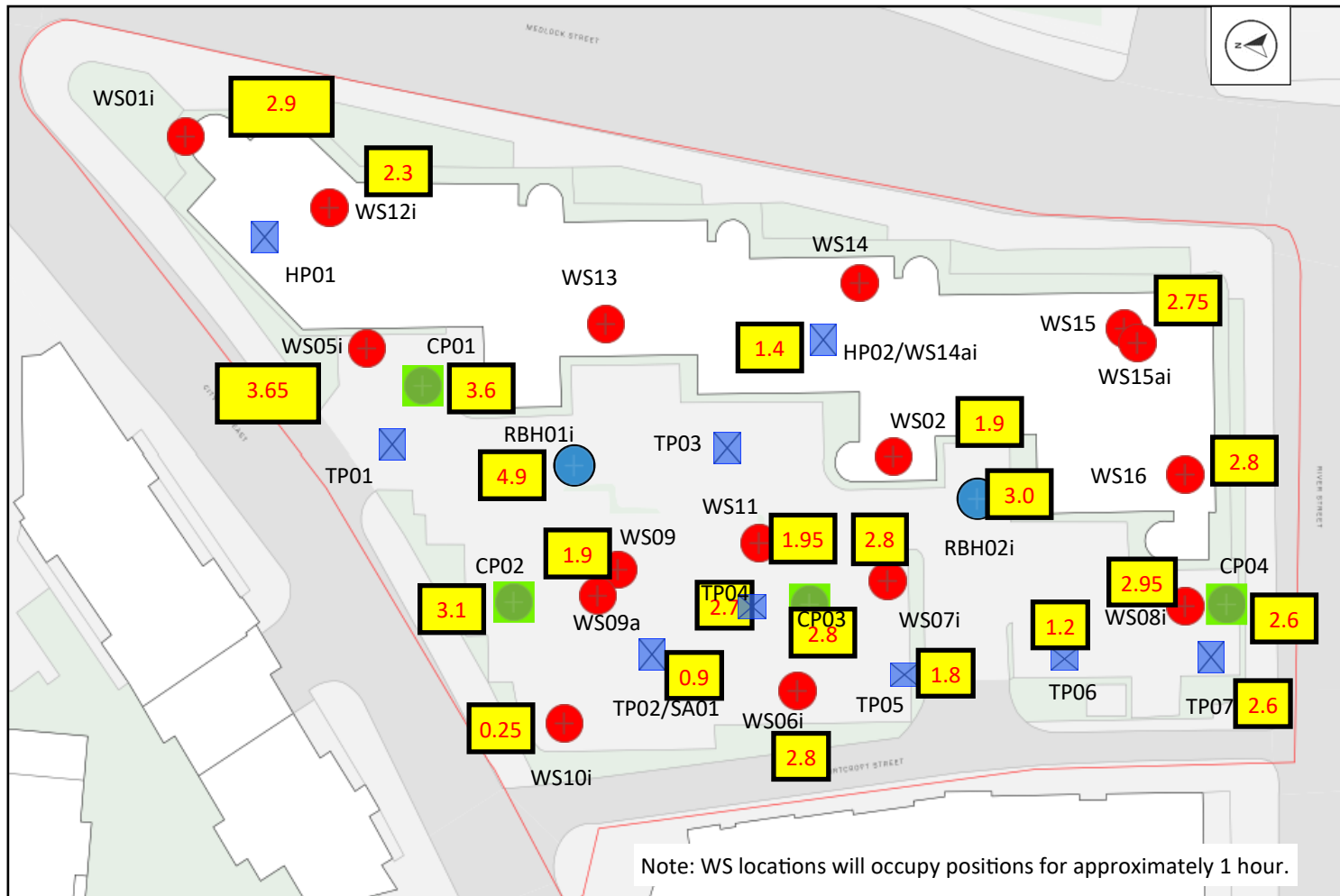
Title:
River Medlock Water Sampling Plan



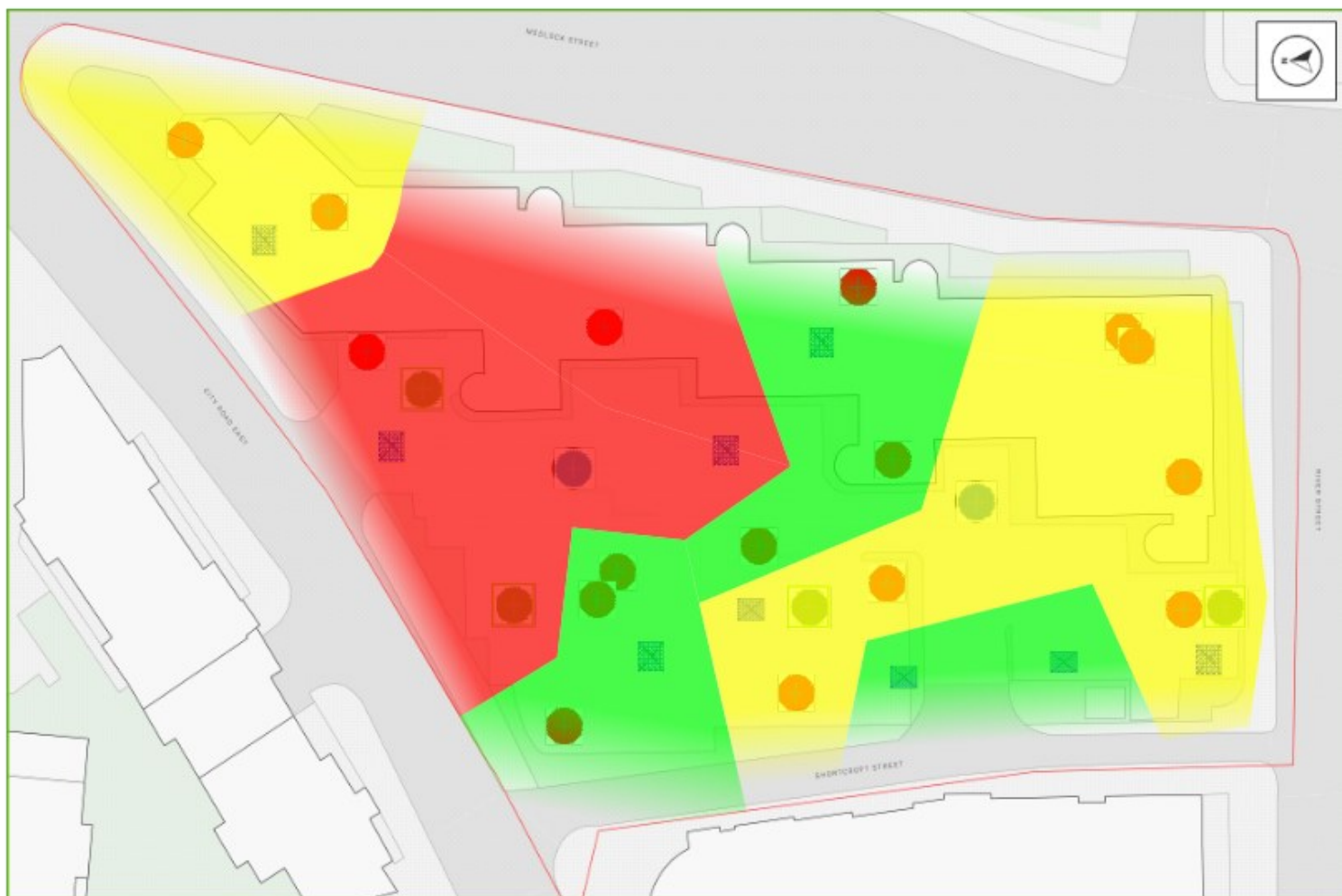
WS and TP exploratory holes within the centre of the site. Areas of investigation comprise former Saw Mill hosting former incinerator/chimney.

RBH1 & 2 under centre of 2no. proposed building footprints which should highlight any contaminant plume migration from the adjacent gas works

WS and TP exploratory holes within the south of the site. Areas of investigation comprise former road and timber yard.



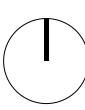
Key	
	Approximate Site Boundary
	NX Consulting Handheld Window Sampler Bore-holes (WS) to maximum depths of 6.45mbgl.
i	Denotes NX groundwater/gas installation
	NX Machine Excavated Trial pit (TP)
	NX Manually Excavated Hand pit (HP)
	NX Consulting Rotary Core Boreholes, to maximum depths 22.00m bgl (RBH)
	NX Consulting Cable Percussive Boreholes, to maximum depths 7.00m bgl (CP)



Key	
	Approximate Site Boundary
	Made Ground Depth: GL to <2.0m bgl
	Made Ground Depth: 2.0m to 3.0m bgl
	Made Ground Depth: >3.0m bgl



Notes:
 Site Application Boundary



Project Name: One City Road		Title: Existing Site Location Plan		Scale: 1:1250 @ A1	
Drawn:	Checked:	Status:	Project:	Drawing No:	Rev:
FM	MH	Planning	140	_MP_00_1000	C
Details: C 11/09/20		Issued for Planning			

Jon Matthews Architects

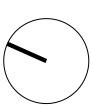
22 City Tower, Piccadilly Plaza, New York St, Manchester, M1 4BT 0161 974 3690

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Notes:

Site Application Boundary

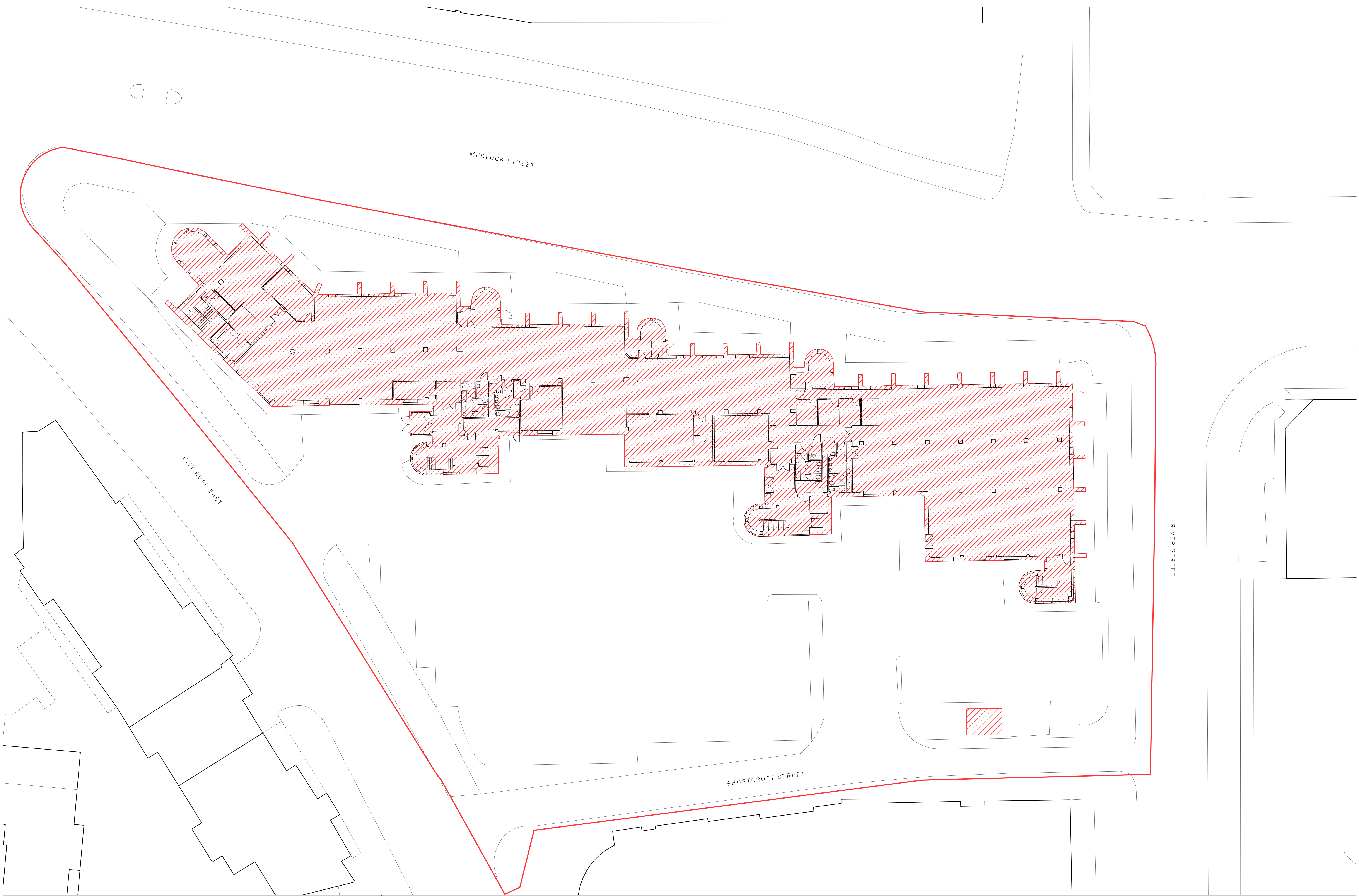


Project Name:		Title:		Scale:	
One City Road		Red Line		1:200 @ A1	
		Boundary Plan			
Drawn:	Checked:	Status:	Project:	Drawing No:	Rev:
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Details:					
- 11/09/20 Issued for Planning					

Jon Matthews Architects

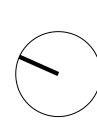
22 City Tower, Piccadilly Plaza, New York St, Manchester, M1 4BT 0161 974 3690

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Notes:

- Site Application Boundary
- Area to be Demolished



Project Name: One City Road		Title: Demolition Site Plan		Scale: 1:200 @ A1	
Drawn: FM	Checked: MH	Status: Planning	Project: 140	Drawing No: _MP_00_1100	Rev: -
Details: - 11/09/20 Issued for Planning					

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Notes:

Site Application Boundary

PLAN KEY:

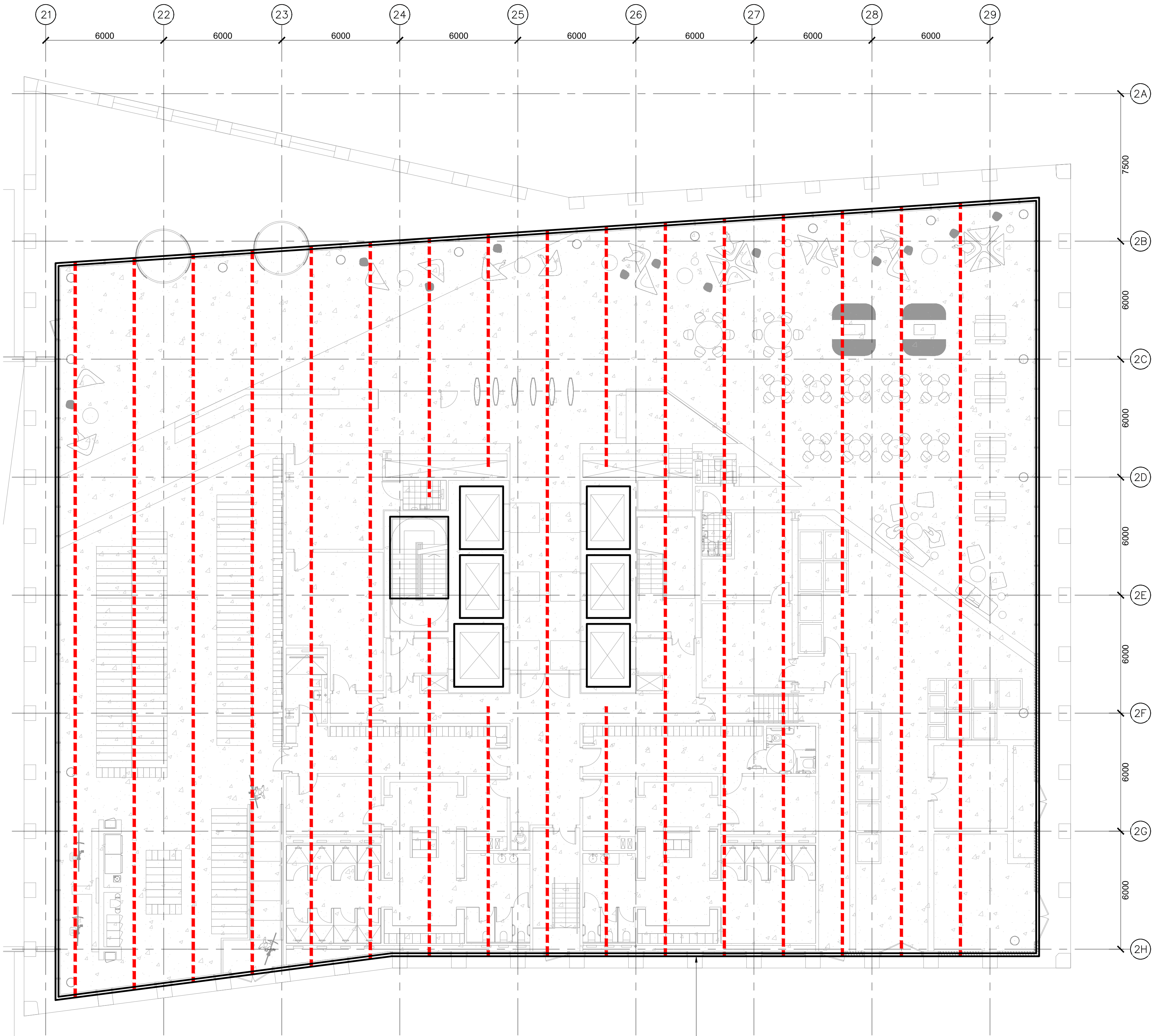
01 Block 01 roof plan	04 Plot 9	07 Car park	10 Offices	13 HOME Manchester	16 Number 1 - retail and offices	19 Vita - student accommodation
02 Block 02 roof plan	05 Medlock Street junction with Mancunian Way	08 Plot 10	11 Sainsburys / Junk Yard Golf Club	14 Number 8 - retail, leisure and office	17 James Grigor Square	20 Plot 11, First Street
03 New landscaping	06 Existing Premier Inn	09 Residential	12 INNSIDE Manchester	15 Tony Wilson Place	18 Q-Park	21 River Street tower

Project Name:		Title:		Scale:	
One City Road		Proposed Site Plan		1:500 @ A1	
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Details:					
- 11/09/20		Issued for Planning			

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22 City Tower, Piccadilly Plaza, New York St, Manchester, M1 4BT 0161 974 3690

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BLOCK 2 - INDICATIVE PERMEABLE STONE FILLED TRENCHES LAYOUT
SCALE 1:125

Indicates extent of ground floor slab.

Ground floor slab to be 150mm thick RC30 ground bearing slab, reinforced top & bottom. Slab to be poured sequentially to limit restraint stresses.

All slab penetrations to be sealed with low permeability gas membrane (e.g. visqueen gas barrier) installed in strict accordance with the manufacturers details & independently validated in accordance with CIRIA 735.

PLEASE NOTE:

Gas protection measures to CS2 in accordance with BS 8485:2015+A1:2019 to achieve 2.5 points.

Gas protection subject to detailed design by specialist contractor.

LEGEND KEY:

REF.	DESCRIPTION.
	Indicates location of passive venting by permeable stone filled trenches.
---	Locations and design subject to detailed design by specialist contractor.

NOTES

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- This drawing is to be read in conjunction with all relevant contractual documents.
- Anyone using this drawing must be aware of their legal duties under the CDM Regulations 2015, refer to the HSE website for further information. BKPL are not Principal Designers.
- All dimensions shown on this drawing are in millimeters unless noted otherwise.
- If the Contractor consider that they do not have sufficient information to safely complete the works detailed on this drawing, they should contact the Engineer.
- All works are to be carried out in accordance with the Building Regulations (as amended) and to the approval of Building Standards.

P1	25.01.24	PRELIMINARY ISSUE	CJM
REV.	DATE	REVISION DETAILS	INITIALS

bk

boothking
PARTNERSHIP LIMITED

CONSULTING CIVIL & STRUCTURAL ENGINEERS

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MANCHESTER Tel: 0161 694 7087	RAMSBOTTOM Tel: 01706 822 022	EDINBURGH Tel: 0131 229 1547
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PROJECT:

1 City Road

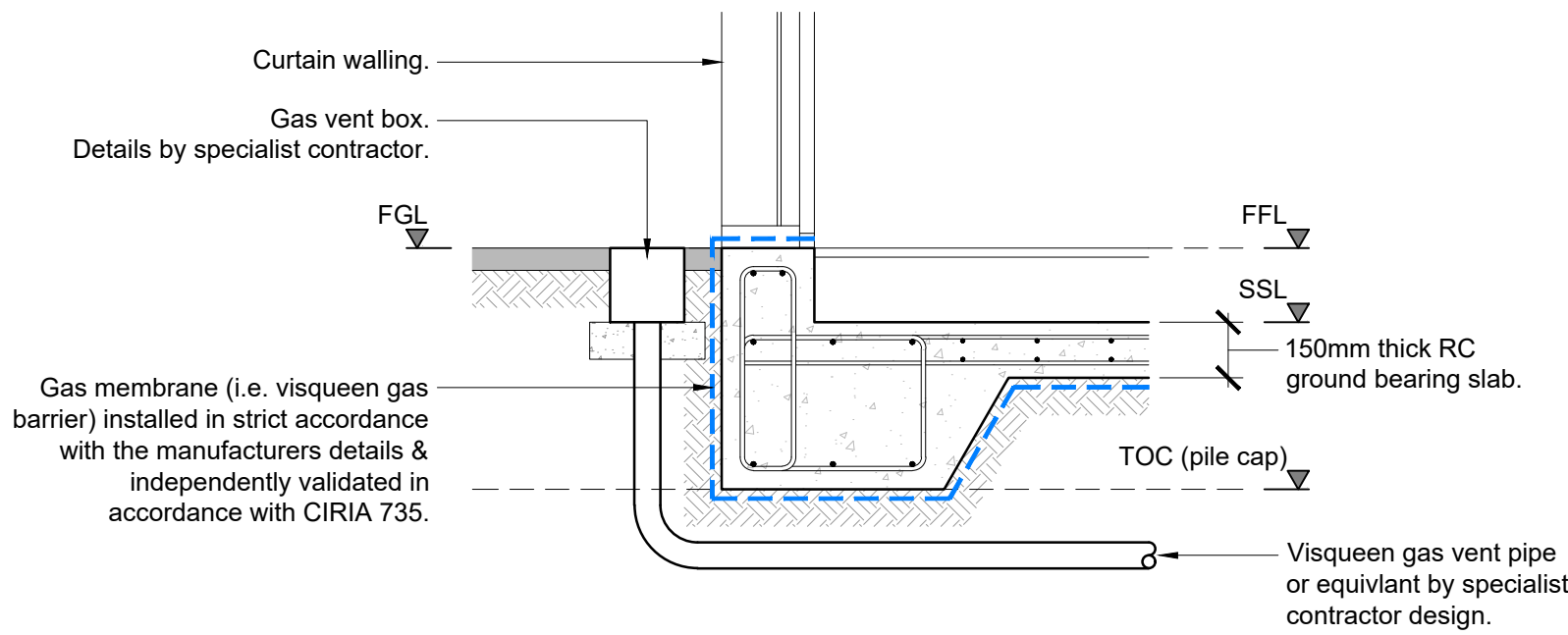
TITLE:

Block 2 - Proposed Gas Protection Measures

SCALE @ A1:	DRAWN:	DATE:	REVISION:	STATUS:
As noted	CJM	JAN 24	P1	

DRAWING No:

13842-BKP-V2-00-DR-S-2900



INDICATIVE SLAB EDGE DETAIL AT PRESSURE RELIEF PIPE
SCALE 1:20

PRELIMINARY

Visqueen Low Permeability Gas Membrane

Features and benefits

- BBA certified - third party accreditation
- Complies with NHBC Foundation's NF94 guidance for use in Type A and Type B membrane locations in reinforced cast in situ suspended floor slabs and rafts
- Complies with NHBC Amber 1 - suitable for low gas risk NHBC housing sites
- Flexible - easy to detail and install on site
- Supplied centre folded - reduces the risk of cracks in screed and limits creases
- Multi functional - also acts as a radon and damp proof membrane
- Dual jointing methods - lap joints can be taped or heat welded

Product description

Visqueen Low Permeability Gas Membrane is a robust co-polymer thermoplastic gas membrane, 0.5mm thick, yellow in colour and supplied 4m x 12.5m in a center folded roll.

Approvals and standards

- Third party accreditation (BBA 13/5069)
- Complies with NHBC Foundation's NF94 guidance for use in Type A and Type B membrane locations in reinforced cast in situ suspended floor slabs and rafts
- Conforms to the specification requirements of NHBC Amber 1 applications
- Conforms to the specification requirements of BR 211:2023
- CE Mark EN 13967:2017
- Quality Management System ISO 9001:2015
- Occupational Health and Safety System ISO 45001:2018
- Environmental Management System ISO 14001:2015

Usage

Visqueen Low Permeability Gas Membrane can be used as a high performance radon membrane and/or damp proof membrane positioned within the ground floor construction either above or below the structural floor slab.

Radon, carbon dioxide and methane protection – NHBC NF94 guidance:

Visqueen Low Permeability Gas Membrane when installed with either taped or welded joints complies with NHBC Foundation's NF94 publication, Hazardous ground gas - an essential guide for housebuilders, in Type A membrane locations in cast in situ monolithic reinforced ground bearing rafts and reinforced cast in situ suspended floor slabs with minimal penetrations. Visqueen Low Permeability Gas Membrane also complies with this guidance when installed with welded joints in Type B membrane locations in cast in situ monolithic reinforced ground bearing rafts and reinforced cast in situ suspended floor slabs with minimal penetrations. For site or zone characteristic gas situations of CS4 and above, contact Visqueen Technical Services.

Carbon dioxide and methane protection – NHBC Traffic Light System:

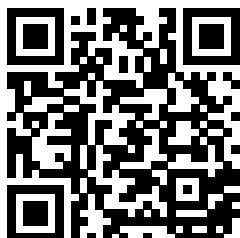
Visqueen Low Permeability Gas Membrane is suitable to prevent the ingress of harmful levels of ground gases for housing applications where NHBC are the warranty provider and the site has been classified as Amber 1. In this application, the membrane is used above a precast suspended segmental subfloor, e.g. beam and block floor.

The product is not intended for use where there is a risk of hydrostatic pressure.

System components

- VisqueenPro Double Sided Jointing Tape, 50mm x 10m
- Visqueen Gas Resistant Foil Lap Tape, 75mm x 50m
- Visqueen Top Hat Units
- VisqueenPro Detailing Strip, 300mm x 10m, 500mm x 10m
- Visqueen TreadGUARD 300, 2m x 75m
- Visqueen TreadGUARD 1500, 1m x 2m

Find your local stockist



Visqueen Low Permeability Gas Membrane

Storage and handling

Visqueen Low Permeability Gas Membrane should be stored horizontally, under cover in its original packaging.

Care should be taken when handling the product in line with current manual handling regulations.

Preparation

Visqueen Low Permeability Gas Membrane should be installed on a smooth continuous substrate free from irregularities such as voids or protrusions e.g. grouted beam and block floor, 50mm thick sand blinding, or smooth concrete blinding.

The membrane can be cut with a sharp retractable safety knife or robust scissors.

Installation

Visqueen Low Permeability Gas Membrane should be loose laid on the substrate. The membrane should be clean and dry at the time of jointing. It should be overlapped by at least 150mm, bonded with Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Foil Lap Tape. In demanding site conditions seal lap joints with Visqueen Ultimate GR Lap Tape. Alternatively lap joints can be heat welded to achieve an effective seal. The overlap in the barrier is typically 100mm and when hand welding, a 35mm weld is normally achieved. When hand welding, a roller must be used.

Airtight seals should be formed around all service entry points. Visqueen Preformed Top Hat Units are available for sealing service entry pipes. The base of the top hat and the upstand should be bonded using Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Foil Lap Tape. The upstand should be secured with the supplied jubilee clip. Alternatively VisqueenPro Detailing Strip can be used to seal service entry points. The upstand should be secured with a jubilee clip.

Forming an effective barrier to gases may give rise to complex three-dimensional detailing where, it is recommended Visqueen Preformed Units are used e.g. corners. Alternatively VisqueenPro Detailing Strip can be used to seal awkward junctions.

If the membrane is punctured or perforated a patch of the same material should be lapped at least 150mm beyond the limits of the puncture and either heat welded or bonded with Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Foil Lap Tape. Alternatively a patch can be formed using VisqueenPro Detailing Strip and lapped at least 150mm beyond the extents of the puncture.

Long periods of exposure to ultraviolet light will reduce the effectiveness of the membrane. The membrane should be covered by a protective layer immediately after installation to prevent damage from following trades, ultraviolet light, etc. Care should be taken to ensure that the membrane is not punctured, stretched or displaced when applying a screed or final floor covering. A minimum thickness of 50mm screed is recommended. When reinforced concrete is to be laid over the membrane the wire reinforcements and spacers must be prevented from puncturing the membrane. Where there is a high risk of potential damage, the membrane should be covered with Visqueen TreadGuard protection, screed, or other approved protection material before positioning the reinforcement.

Usable temperature range

It is recommended that Visqueen Low Permeability Gas Membrane and all associated system components should not be installed below 5°C

Additional information

When used in full radon protection areas, a Visqueen Radon Sump or subfloor ventilation system maybe required.

To assist build sequencing, Visqueen Zedex CPT DPC is available for gas protection through masonry wall constructions.

For suspended beam and block floor detailing see LPGM-01.

For internal and external corners Visqueen Preformed Corner Units should be used see PFU-553.

To seal around steel columns use VisqueenPro Detailing Strip see LPGM-52.

For additional detailing information, contact Visqueen Technical Services +44 (0) 333 202 6800.

The product is recyclable and categorised under LDPE recycling code 4.

Visqueen is part of Berry bpi, the largest European recycler of polyethylene. This product is recyclable and should be segregated on site in accordance with site management procedures for plastic waste. We have 4 recycling sites in the UK where the plastic waste could be recycled and converted back into a second life product. Please contact us to find out more.

Visqueen Low Permeability Gas Membrane

Property	Test method	Units	Compliance criteria	Result
Visible defects	EN 1850 -2	-	Pass/Fail	Pass
Length	EN 1848-2	m	-10%/+10%	12.5
Width	EN 1848-2	m	-2.5%/+2.5%	4
Straightness	EN 1848-2	-	Pass/Fail	Pass
Thickness	EN 1849-2	mm	-12%/+12%	0.5
Tensile strength - MD	EN 12311	N/mm ²	MLV	15
Tensile strength - TD	EN 12311	N/mm ²	MLV	15
Tensile elongation - MD	EN 12311	%	MLV	400
Tensile elongation - TD	EN 12311	%	MLV	400
Joint strength	EN 12317-2	N	MDV	298
Watertightness 2kPa	EN 1928	-	Pass/Fail	Pass
Resistance to impact	EN 12691	mm	>MLV	200
Durability (artificial ageing)	EN 1296 and EN 1928	-	Pass/Fail	Pass
Durability chemical resistance	EN 1847	-	Pass/Fail	Pass
Resistance to tearing (nail shank) CD	EN 12310-1	N	MDV	333
Resistance to tearing (nail shank) MD	EN 12310-1	N	MDV	335
Radon permeability	SP Test Method	m ² /s	MDV	5.477 x 10 ⁻¹²
Radon transmittance	SP Test Method	m/s	MDV	1.095 x 10 ⁻⁸
Carbon dioxide permeability	ISO 2782	m/s/Pa	MDV	2.8 x 10 ⁻¹⁷
Methane gas transmission rate	ISO 15105-1	ml/m ² /day/atm	MDV	213
Reaction to fire	EN 13501-1	Class	MDV	F
Water vapour resistance	EN 1931	MNs/g	MDV	1445
Water vapour - permeability/ density flow rate	EN 1931	g/m ² /d	MDV	0.1239
Equivalent air layer thickness	EN 1931	SD in m	MDV	290
Water vapour resistance factor	EN 1931	u	MDV	615,000

Health and safety information

Refer to the Visqueen Low Permeability Gas Membrane safety datasheet (SDS).

Visqueen Low Permeability Gas Membrane

About Visqueen

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For further guidance on the Visqueen services shown below, please refer to the relevant section of the Visqueen website (www.visqueen.com) or contact Visqueen Technical Services on +44 (0) 333 202 6800 or enquiries@visqueen.com

Complete Range, Complete Solution



Structural
Waterproofing



Gas
Protection



Damp Proof
Membrane



Tapes



Damp Proof
Course



Stormwater



Vapour
Control

Visqueen Technical Support

Visqueen combine an extensive product portfolio with industry leading levels of service and support which includes guidance over the phone, bespoke CAD drawings to help with complex detailing, electronic NBS specifications and access to a dedicated team of highly knowledgeable and experienced field based Technical Support Managers.

Visqueen Technical Support is available to all our customers including architects, specifiers, distributors, builders merchants, contractors and end users. All of our technical team have been awarded the industry recognised qualification Certificated Surveyor in Structural Waterproofing (CSSW).

Visqueen CPD Seminars

The Visqueen Continuing Professional Development (CPD) Seminars provide up-to-date information on changes within Building Regulations/Building Standards and nationally recognised industry guidance affecting damp proofing, water vapour control, hazardous ground gas protection and below ground structural waterproofing.

The one hour seminars have been produced for design specialists within the construction sector and are delivered by our team of Technical Support Managers.

Visqueen PI designs and special projects

From initial design to the completed project, Visqueen are with you every step of the way. Whether it be hazardous ground gas protection and/or below ground waterproofing protection employing barrier, structurally integral or drained systems, Visqueen can offer professional indemnity (PI) insurance for bespoke Visqueen design solutions.

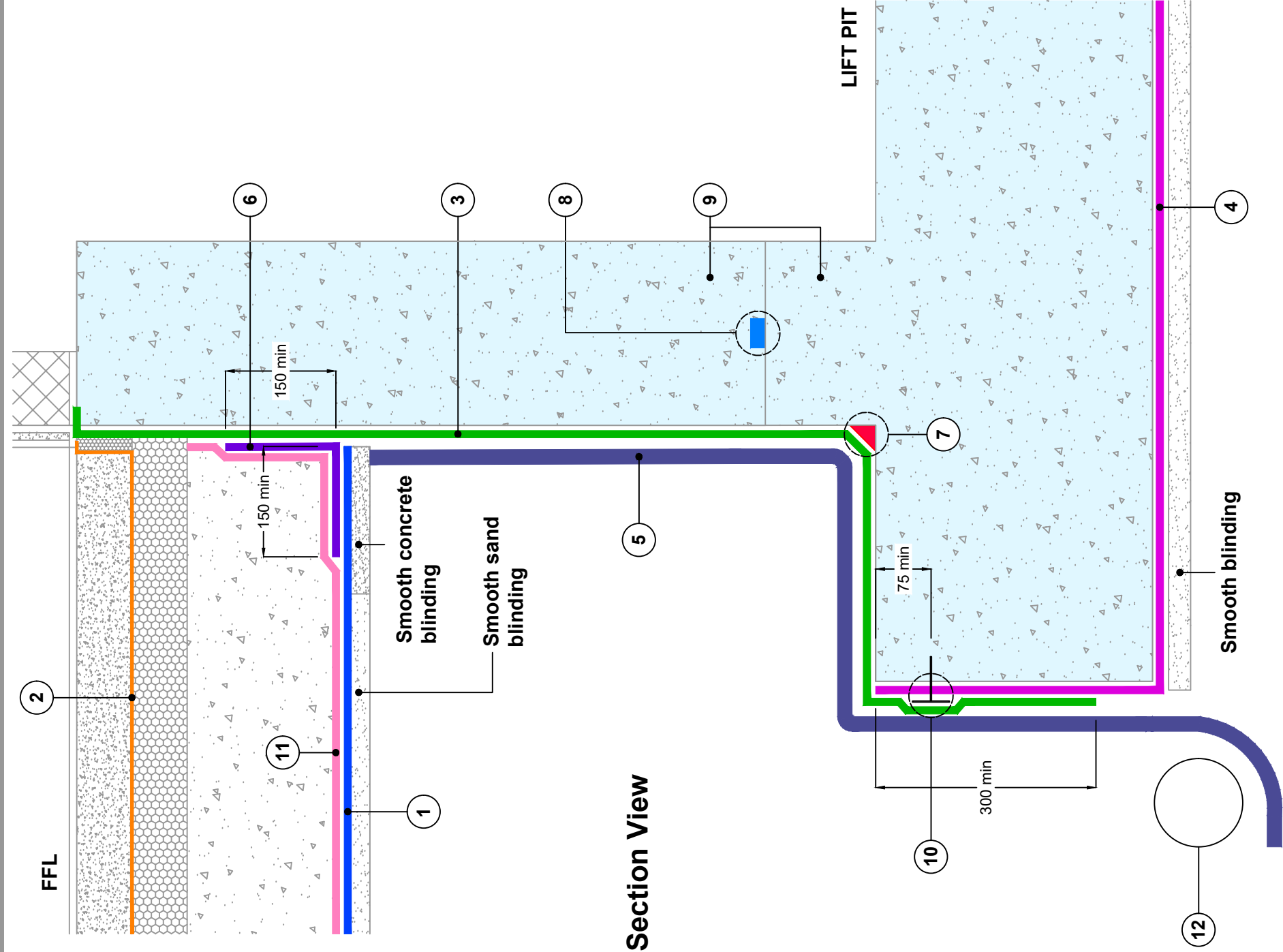
Visqueen Technical Support Managers work with all stakeholders to provide cost effective Visqueen solutions offering complete peace of mind throughout the construction phase and beyond.

Visqueen Training Academy

Based at our manufacturing facility in Derbyshire, the Visqueen Training Academy is available to support Visqueen customers throughout the UK by providing a wide range of both theory and practical skills related training.

Courses include one day product awareness training for our distributors and builders merchants to help them in their day-to-day jobs, through to intensive three day courses giving detailed hands-on training in the practical skills required for safe and robust product installation.

Key to materials:	
1	Visqueen Gas Barrier
2	Visqueen Vapour Check or Visqueen Vapour Barrier
3	Visqueen Gas Resistant Self Adhesive Membrane on Visqueen HP Tanking Primer
4	Visqueen Ultimate Geoseal
5	Visqueen Protect&Drain, 12mm
6	VisqueenPro Detailing Strip
7	Visqueen Axiom UniSeal fillet, 35mm x 35mm
8	Visqueen IGW10 Waterstop bedded in Visqueen Waterstop Adhesive
9	Visqueen IGW Watertight Concrete
10	Visqueen Ultimate Retaining Discs at 400mm centres
11	Visqueen TreadGUARD
12	Maintainable land drain by others



CRITICAL GUIDANCE NOTES
Visqueen Guidance Details are for illustration purposes only. It is the lead designer's responsibility to ensure Guidance Details are incorporated correctly into construction drawings.
Visqueen take no project design liability, or responsibility for the use of Guidance Details. Visqueen have no control over the situation in which the products are installed. Visqueen provide a Contract Design Service where project specific drawings can be produced. Contact Visqueen Technical Services for further information.
Site construction sequencing should be assessed before the appropriate Guidance Detail is selected and approved by the lead designer.
All Visqueen materials must be installed in strict accordance with the Visqueen Product Datasheets and applicable third party certificates.
Lift pit changes of direction to be reinforced with 300mm wide strip of Visqueen Gas Resistant Self Adhesive Membrane on Visqueen HP Tanking Primer prior to installation of primary layer (3) shown on detail.
DPCs and DPC cavity trays to be installed in accordance with BS 8215:1991, PD 6697:2019 and BS 8000-3:2020.
Radon protection in accordance with national building regulations and BR211:2023.
Ground gas protection in accordance with BS 8485:2015 + A1:2019.
Further protection such as ventilation measures (not shown) may be necessary to meet the requirements of BS8485:2015+A1:2019.
Visqueen air and vapour control layers (AVCLs) should be installed in accordance with the recommendations of BS 5250:2021.
Drawing not to scale, use figured dimensions only. All figured dimensions are in millimetres.

Guidance Detail	
Date: November 2023	
Drawing No: SW-GB-01	
Revision: A	Drawn by: JR
Approved by: SD	



Tel: 0333 202 6800
enquiries@visqueen.com
www.visqueen.com



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1	<p>Visqueen membrane as specified. On-site heat weldable membranes include the following:</p> <ul style="list-style-type: none">- Visqueen High Performance Damp Proof Membrane- Visqueen Radon R400 Membrane- Visqueen Ultimate RadonBlok 400- Visqueen Ultimate RadonBlok 600- Visqueen Low Permeability Gas Membrane- Visqueen Gas Barrier- Visqueen Ultimate HC Blok- Visqueen High Performance Urban Drainage Geomembrane	<div>CRITICAL GUIDANCE NOTES</div> <p>Visqueen Guidance Details are for illustration purposes only. It is the lead designer's responsibility to ensure Guidance Details are incorporated correctly into construction drawings.</p> <p>Visqueen take no project design liability, or responsibility for the use of Guidance Details. Visqueen have no control over the situation in which the products are installed. Visqueen provide a Contract Design Service where project specific drawings can be produced. Contact Visqueen Technical Services for further information.</p> <p>Site construction sequencing should be assessed before the appropriate Guidance Detail is selected and approved by the lead designer.</p> <p>All Visqueen materials must be installed in strict accordance with the Visqueen Product Datasheets and applicable third party certificates.</p> <p>This detail relates to the formation of a sealed lap joint using a hot air hand welder and roller. Other lap joint heat welding techniques are suitable including wedge welding.</p> <p>Drawing not to scale, use figured dimensions only. All figured dimensions are in millimetres.</p>
2	Visqueen TreadGUARD protection where specified	
3	Smooth substrate e.g. sand blinding	

The diagram illustrates a hand-welded lap joint detail for a Visqueen membrane. It shows three distinct layers: 1. A smooth substrate (e.g., sand blinding) at the base. 2. A Visqueen membrane layer on top of the substrate. 3. A Visqueen TreadGUARD protection layer on top of the membrane. The diagram shows a lap joint where two sheets of the membrane overlap. The overlap is divided into two sections: a '35mm min welded lap' where the two sheets are joined by a hot air weld, and a '100mm min overlap' where the two sheets are simply placed on top of each other without being welded. Callout numbers 1, 2, and 3 point to the substrate, the membrane, and the TreadGUARD protection respectively.

Visqueen

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Visqueen

HAND WELDED LAP JOINT DETAIL

CRITICAL GUIDANCE NOTES

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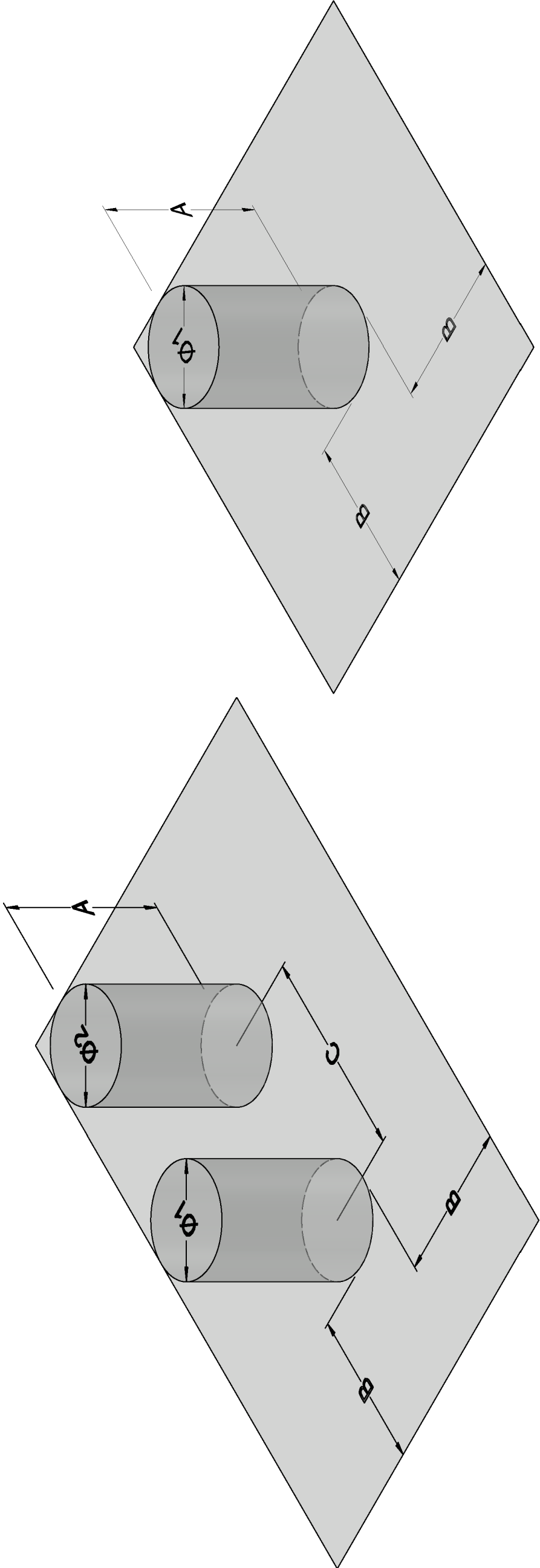
Visqueen take no project design liability, or responsibility for the use of Guidance Details. Visqueen have no control over the situation in which the products are installed. Visqueen provide a Contract Design Service where project specific drawings can be produced. Contact Visqueen Technical Services for further information.

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DPCs and DPC cavity trays to be installed in accordance with BS 8215:1991, PD 6697:2019 and BS 8000-3:2020.

Drawing not to scale, use figured dimensions only. All figured dimensions are in millimetres.



Double Pipe Sleeve	
Unit Ref:	
Diameter Ø1	
Diameter Ø2	
A	
B	
C	
Quantity	

Zedex Units	
Ultimate Units	

Single Pipe Sleeve	
Unit Ref:	
Diameter Ø1	
A	
B	
Quantity	

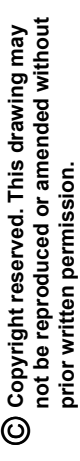
Guidance Detail	
Date: September 2023	
Drawing No: PFU-203	
Revision: B	Drawn by: JR
Approved by: SD	



PREFORMED PIPE SLEEVES



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www.visqueen.com



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VisqueenPro Gas Vent Box

Features and benefits

- Versatile - suitable for all ground gas venting applications including volatile organic compounds (VOCs)
- Tested to BS EN 1433:2002 - suitable for loads up to 12.5 tonnes
- Heel safe lids - suitable for use in pedestrian areas
- Lid locking mechanism - provides security and allows for maintenance
- System allows for water management - reduces risk of rainwater entering the void

Product description

VisqueenPro Gas Vent Box comprises a galvanised steel base with a 110mm pipe inlet and adjustable feet for leveling purposes and to secure the box within the concrete surround. The galvanised steel grating lid is 530mm x 123mm and is secured with locking bolts. The lid is 'heel' safe approved.

Each vent box provides a free air flow capacity of 20148mm².

Approvals and standards

- Conforms to BS EN 1433: 2002, load class B125
- Quality Management System ISO 9001:2015

Usage

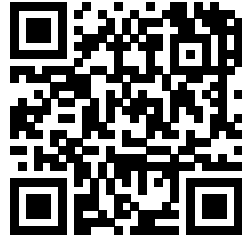
VisqueenPro Gas Vent Box is a high performance ground level vent box that when installed as part of a Visqueen gas venting system will safely disperse harmful gases to atmosphere and reduce the risk of rainwater entering the void. The product can also be used to ventilate air spaces e.g. the open void below suspended precast concrete floor structures.

The vent box is typically used in applications where the gas dispersal system cannot be taken out through a perimeter masonry wall e.g. curtain walling and glazing systems. The vent box is normally positioned close to the building perimeter wall but is suitable for load class B125 to BS EN 1433:2002 which includes pedestrian precincts, light vehicles and private car parks.

System components

- Visqueen Venting Pipework and Connectors

Find your local stockist





VisqueenPro Gas Vent Box

Technical support: +44 (0) 333 202 6800
Date Published: 10/02/2021

Storage and handling

VisqueenPro Gas Vent Box should be stored under cover in the original packaging.

Care should be taken when handling the product in line with current manual handling regulations.

Preparation

The VisqueenPro Gas Vent Box should be connected to a suitable soakaway to drain rainwater entering through the vent box grating.

For stability, minimum 50mm concrete to Strength Class C25/30 is required beneath and around the vent box.

Installation

Ensure all below ground Visqueen Gas Vent Pipe push-fit pipework joints are secure and the sub-base is well compacted before positioning and leveling the Visqueen Pro Gas Vent Box.

Connect the vent box to the vent pipe ensuring that the top of the vent box grating is either flush or slightly below the external ground level hard landscaping. NB. The grating must not protrude above the external ground level.

Bed the vent box on minimum 50mm concrete (Strength class C25/30 to BS EN 206:2013 + A1:2016) and surround with the same. Remove any concrete spill before it sets and clean off residue with soapy water.

Usable temperature range

There are no temperature range restrictions for installing Visqueen Pro Gas Vent Box and associated system components.

Additional information

Please ensure that VisqueenPro Gas Vent Box is suitable for your intended application. Stainless steel vent boxes and vent boxes for classes higher than B125 ratings are also available.

After the building has been occupied, please ensure that the guidelines on the loadings are followed as once installed, Visqueen cannot take responsibility for damage caused by traffic moving over the vent box.

Where heavy vehicles are temporary moving over the vent box e.g. during building maintenance, please ensure the vent box is plated to prevent damage.

For additional detailing information, contact Visqueen Technical Services +44 (0) 333 202 6800



VisqueenPro Gas Vent Box

Property	Units	Value or Statement
Width	mm	123
Length	mm	530
Height without legs	mm	112
Load class		B125
Free air flow capacity	mm ²	20148

Health and safety information

Refer to the Visqueen Pro Gas Vent Box material safety datasheet (MSDS).

VisqueenPro Gas Vent Box

About Visqueen

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Complete Range, Complete Solution

						
Structural Waterproofing	Gas Protection	Damp Proof Membrane	Tapes	Damp Proof Course	Stormwater	Vapour Control

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Visqueen PI designs and special projects

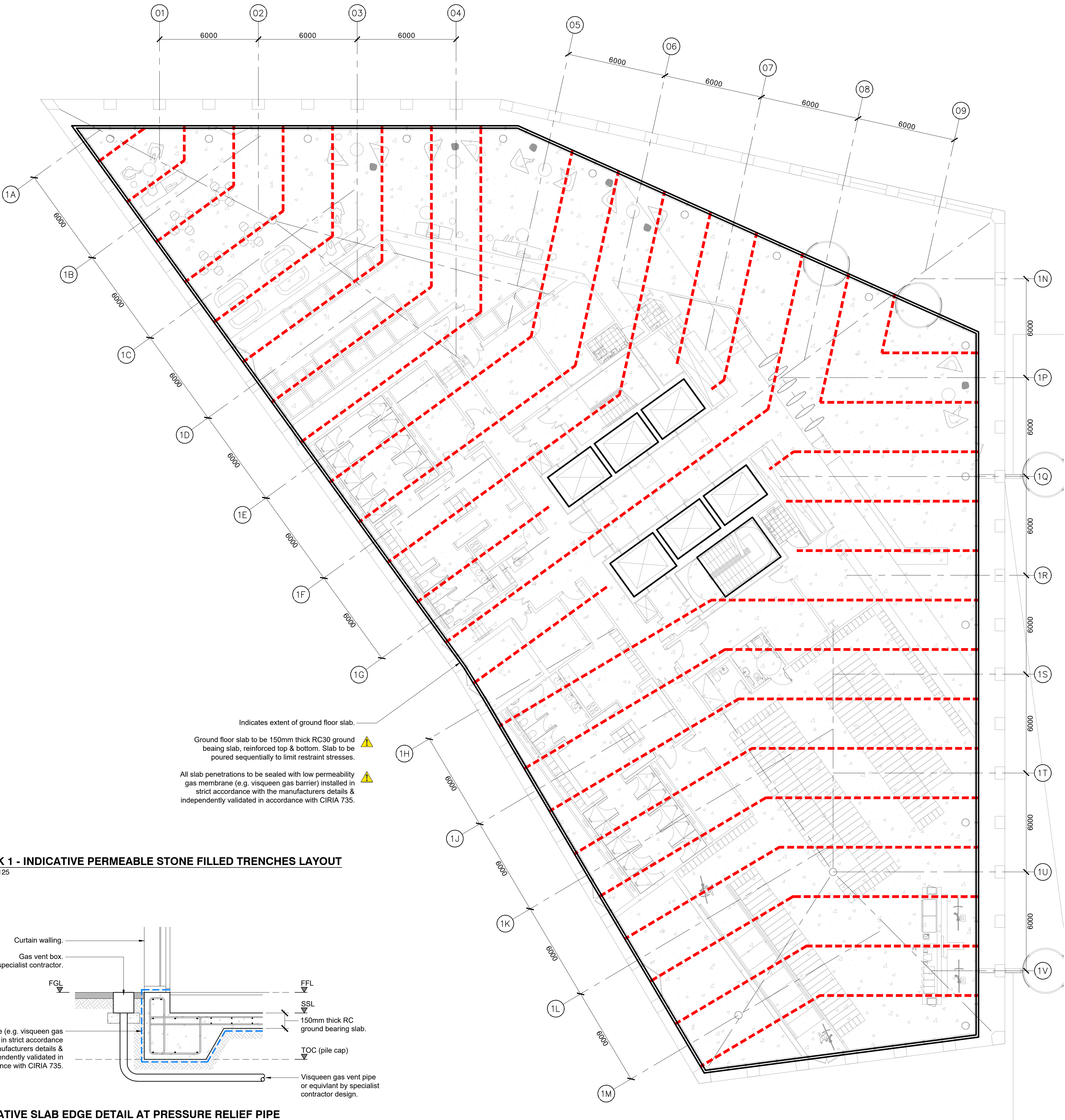
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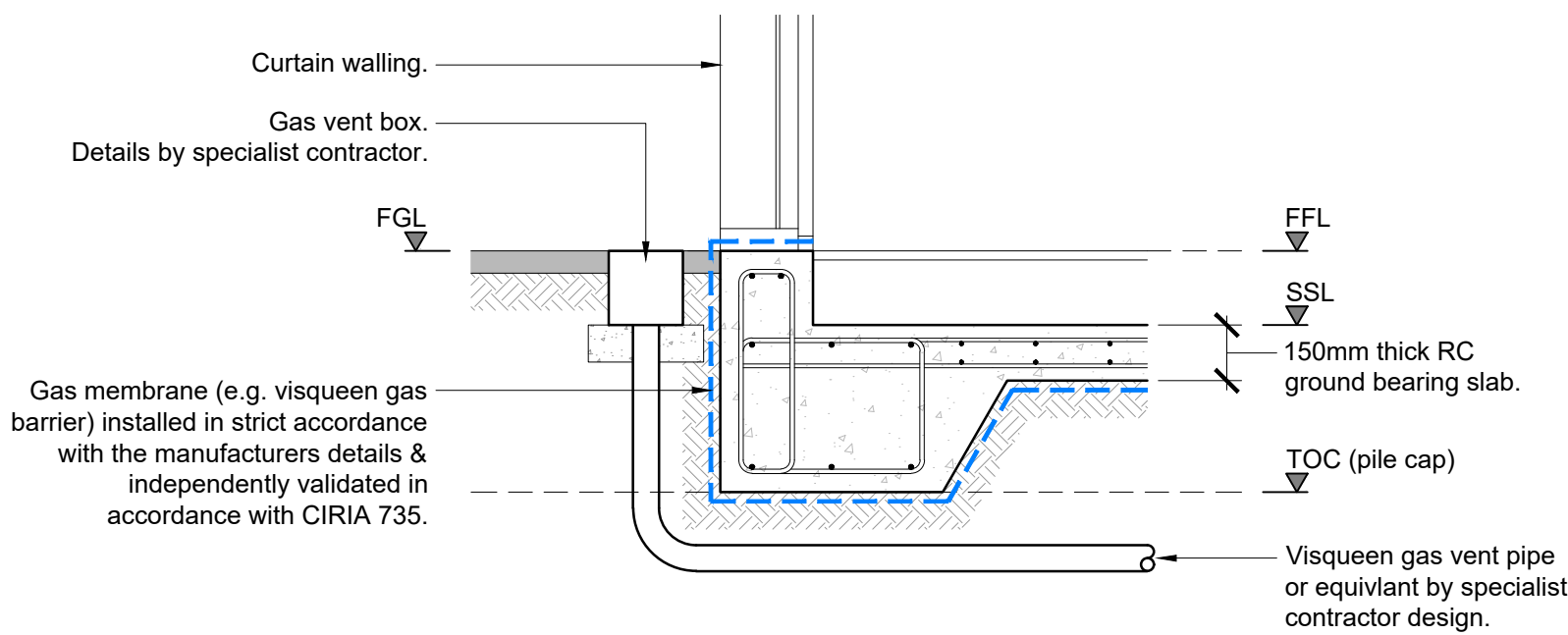
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BLOCK 1 - INDICATIVE PERMEABLE STONE FILLED TRENCHES LAYOUT
SCALE 1:125



INDICATIVE SLAB EDGE DETAIL AT PRESSURE RELIEF PIPE
SCALE 1:20

PLEASE NOTE:

Gas protection measures to CS2 in accordance with BS 8485:2015+A1:2019 to achieve 2.5 points.

Gas protection subject to detailed design by specialist contractor.

LEGEND KEY:	
REF.	DESCRIPTION.
	Indicates location of passive venting by permeable stone filled trenches.
	Locations and design subject to detailed design by specialist contractor.

- NOTES**
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 - This drawing is to be read in conjunction with all relevant contractual documents.
 - Anyone using this drawing must be aware of their legal duties under the CDM Regulations 2015, refer to the HSE website for further information. BKPL are not Principal Designers.
 - All dimensions shown on this drawing are in millimeters unless noted otherwise.
 - If the Contractor consider that they do not have sufficient information to safely complete the works detailed on this drawing, they should contact the Engineer.
 - All works are to be carried out in accordance with the Building Regulations (as amended) and to the approval of Building Standards.

P1	25.01.24	PRELIMINARY ISSUE	CJM
REV.	DATE	REVISION DETAILS	INITIALS

boothking
PARTNERSHIP LIMITED
CONSULTING CIVIL & STRUCTURAL ENGINEERS
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MANCHESTER Tel: 0161 694 7087
RAMSBOTTOM Tel: 01706 822 022
EDINBURGH Tel: 0131 229 1547

PROJECT:

1 City Road

TITLE:

Block 1 - Proposed Gas Protection Measures

SCALE @ A1:	DRAWN:	DATE:	REVISION:	STATUS:
As noted	CJM	JAN 24	P1	

DRAWING No:

13842-BKP-V1-00-DR-S-1900

PRELIMINARY

Appendix B – NX Consulting Protocol for Validation of Soil Cover Systems



NX Consulting Limited Protocol for Validation of Soil Cover

Isolation of potentially contaminated or unsuitable materials in garden and landscaped areas beneath a cover of “clean” subsoil, and topsoil is often recommended on developments to allow safe use and/or occupation of the land; most notably when it contains inorganic contaminants at concentrations above guidance threshold values.

A cover is only required in proposed garden and/or landscaped areas (i.e. not beneath drives, garages or houses). The soil cover, hard standing breaks direct contact pollutant linkages between the potentially contaminated soils and future residents or end users.

The CML initiative requires house builders to submit to the NHBC (or other warranty providers) a validation report confirming the thickness and chemical suitability of the soil cover.

Validation reports are normally prepared by independent geoenvironmental consultants such as NX Consulting. Soil cover validation requires independent assessment of the chemical suitability of the soil and the thickness of the placed subsoil and topsoil.

Inspection and Sampling of cover soil at source

Soil quality is best determined by sampling at the **source** at least 7 working days before importation to the development site. If this is achieved, further, on-site (post-placement) quality testing should not usually be necessary providing that confirmation can be given that the material arriving at site is the same soil as that tested.

Inspection and Sampling of cover soil following import to site

In some cases, soil is often delivered to site prior to sampling and chemical testing. Such soils should be stockpiled in a secure location on site and NX Consulting should be contacted to arrange for visual inspection, sampling and chemical testing. It is strongly recommended that soils should not be placed in garden, P.O.S and landscaped areas, prior to confirmation of the suitability of the soil ~~by NX Consulting~~. This normally takes two weeks from initial notification.

Suitable soil material should:

- be clean and free of foreign debris, building waste materials or contaminants;
- not have a stone content of greater than 20% by visual estimation
- have a maximum stone size of 150mm in any one direction.
- 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).

The number of samples taken will be dependant on the nature of the source and the quantity of material to be imported and the testing ratio should be agreed with the Local Authority (EHO) before testing is undertaken. However, the Cover system depths and sample ratios should be carried out in line with Section 6 of Manchester City Council’s Planning and Technical Guidance document relating to ground contamination, dated February 2021. Summary below:

Soil Source	Sampling Frequency*	Analysis suite
Imported Soils - Brownfield source, or unknown soil source	Residential Gardens: 1:50m ³	Standard metals/ metalloids (should include as a minimum As, Cd, Cr, Cr, VI, Cu, Hg, Ni, Pb, Se, Zn), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).
	Soft Landscaping: 1:150m ³	
	Other: 1:200m ³	
Remediated Soils	Residential Gardens: 1:100m ³	Standard metals/ metalloids (should include as a minimum As, Cd, Cr, Cr, VI, Cu, Hg, Ni, Pb, Se, Zn), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).
	Soft Landscaping: 1:150m ³	
	Other: 1:200m ³	
Imported Soils - Greenfield Source	Residential Gardens: 1:200m ³	Standard metals/ metalloids (should include as a minimum As, Cd, Cr, Cr, VI, Cu, Hg, Ni, Pb, Se, Zn), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).
	Soft Landscaping: 1:200m ³	
	Other: 1:200m ³	

Cover layers can often include a “difficult to dig” or capillary break layer of coarse natural or recycled aggregate. Where this aggregate is sourced from recycled materials (such as crushed demolition arisings) asbestos screening tests should also be undertaken.

The Client\Contractor will be notified of the soil’s suitability (or otherwise) immediately following receipt of the results (typically taking 7 working days). Chemical assessment (Tier 1) criteria for imported soils are presented below.

On receipt of written confirmation from NX Consulting, the Client should instruct his Contractor to commence importation. It will probably be necessary to stockpile the cover prior to placement in garden\landscaped areas. NX Consulting should inspect the stockpiled material prior to placement, to confirm that it is the same material as previously tested, **and** the Contractor should provide the Client with appropriate haulage notes.

Cover Thickness Validation

Soil **thickness** can only be checked after placement, but should be done before turfing, fencing etc. Thickness could be checked via the excavation of an appropriate number of inspection trial pits. Typically one trial pit for every two gardens will be required.

The thickness of cover is dependant on the nature and degree of contamination (and often the Local Authority whose area the site lies within), but typically between 600mm and 1,000mm is required. Where underlying materials do not contain contaminants above critical concentrations 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, in accordance with NHBC Standards, Chapter 9.2, should be adequate.

Soil cover is usually placed many weeks after completion of the preparatory\remedial works, and issue of the associated Verification Report. Consequently, site visits, to generate supplementary letter reports, are typically required after soil cover has been placed in the gardens of each plot, or set of plots.

Cover material can sometimes be sourced on-site from foundation\drainage excavations in natural in-situ strata, but import is often necessary.

Issue of Soil Cover Validation Reports

Validation reports will be issued by NX Consulting following the confirmation of the placed thickness within each plot, or set of plots. Each report will contain the following information;

- details of the provenance of the subsoil and topsoil,
- chemical test data,
- an interpretation of the chemical data indicating whether the soils are suitable for use in a clean cover layer,
- a drawing indicating the location of cover thickness validation trial pits,
- photographs of the excavated trial pits confirming the thickness of placed soils,
- a data table indicating the thickness of cover soils within each trial pit excavated.

Soil Cover Validation Reports will be issued to the Local Authority and to the NHBC by email.

NX Consulting Tier 1 Values Version 1 - CLEA 2009 (Software Version 1.06)

	Residential with Homegrown Produce.		Residential without Homegrown Produce.		Commercial Industrial with Landscaping	
Active Pathways	<ul style="list-style-type: none"> • Direct Ingestion • Dermal Contact • Consumption of Vegetables and Attached Soil • Inhalation of Indoor Vapour and Dust • Inhalation of Outdoor Vapours and Dust 		<ul style="list-style-type: none"> • Direct Ingestion • Dermal Contact • Inhalation of Indoor Vapour and Dust • Inhalation of Outdoor Vapours and Dust 		<ul style="list-style-type: none"> • Direct Ingestion • Dermal Contact • Inhalation of Indoor Vapour and Dust • Inhalation of Outdoor Vapours and Dust 	
Critical Receptors	Female Child 0-6yrs Old		Female Child 0-6yrs Old		Female Adult Worker >17 years old.	
Determinand/Units	mg/kg	Source	mg/kg	Source	mg/kg	Source
Arsenic	37	LQM / CIEH S4ULs	40	LQM / CIEH S4ULs	640	LQM / CIEH S4ULs
Cadmium	11	LQM / CIEH S4ULs	85	LQM / CIEH S4ULs	190	LQM / CIEH S4ULs
Mercury (inorganic)	40	LQM / CIEH S4ULs	56	LQM / CIEH S4ULs	1,100	LQM / CIEH S4ULs
Nickel	180	LQM / CIEH S4ULs	180	LQM / CIEH S4ULs	980	LQM / CIEH S4ULs
Selenium	250	LQM / CIEH S4ULs	430	LQM / CIEH S4ULs	1,200	LQM / CIEH S4ULs
Chromium III	910	LQM / CIEH S4ULs	910	LQM / CIEH S4ULs	8,600	LQM / CIEH S4ULs
Chromium VI	6	LQM / CIEH S4ULs	6	LQM / CIEH S4ULs	33	LQM / CIEH S4ULs
Lead	450	C4SLs	450	C4SLs	750	C4SLs
Copper	2,400	LQM / CIEH S4ULs	7,100	LQM / CIEH S4ULs	68,000	LQM / CIEH S4ULs
Zinc	3,700	LQM / CIEH S4ULs	40,000	LQM / CIEH S4ULs	730,000	LQM / CIEH S4ULs
Boron	290	LQM / CIEH S4ULs	1100	LQM / CIEH S4ULs	240,000	LQM / CIEH S4ULs

LQM /CIEH S4ULs Copyright Land Quality Management Limited. Reproduced with permission Publication No. S4UL3671. All right reserved.

Standard Land Use Scenario	Residential with Homegrown Produce			Residential without Homegrown Produce			Commercial			Source
Determinand/SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	
<i>Naphthalene</i>	2.3	5.6	13	2.3	5.6	13	190	460	1100	LQM / CIEH S4ULs
<i>Acenaphthylene</i>	170	420	920	2900	4600	6000	83000	97000	10000	LQM / CIEH S4ULs
<i>Acenaphthene</i>	210	510	1100	3000	4700	6000	84000	97000	10000	LQM / CIEH S4ULs
<i>Fluorene</i>	170	400	860	2800	3800	4500	63000	68000	71000	LQM / CIEH S4ULs
<i>Phenanthrene</i>	95	220	440	1300	1500	1500	22000	22000	23000	LQM / CIEH S4ULs
<i>Anthracene</i>	2400	5400	1100	31000	35000	37000	520000	540000	540000	LQM / CIEH S4ULs
<i>Fluoranthene</i>	280	560	890	1500	1600	1600	23000	23000	23000	LQM / CIEH S4ULs
<i>Pyrene</i>	620	1200	2000	3700	3800	3800	54000	54000	54000	LQM / CIEH S4ULs
<i>Benzo(a)anthracene</i>	7.2	11	13	11	14	15	170	170	180	LQM / CIEH S4ULs
<i>Chrysene</i>	15	22	27	30	31	32	350	350	350	LQM / CIEH S4ULs
<i>Benzo(b)fluoranthene</i>	2.6	3.3	3.7	3.9	4	4	44	44	44	LQM / CIEH S4ULs
<i>Benzo(k)fluoranthene</i>	77	93	100	110	110	110	1200	1200	1200	LQM / CIEH S4ULs
<i>Benzo(a)pyrene</i>	2.2	2.7	3	3.2	3.2	3.2	35	35	35	LQM / CIEH S4ULs
<i>Indeno(1,2,3-cd)pyrene</i>	27	36	41	45	46	46	500	510	510	LQM / CIEH S4ULs
<i>Dibenz(a,h)anthracene</i>	0.24	0.28	0.3	0.31	0.32	0.32	3.5	3.6	3.6	LQM / CIEH S4ULs
<i>Benzo(ghi)perylene</i>	320	340	350	360	360	360	3900	4000	4000	LQM / CIEH S4ULs
<i>Benzene</i>	0.087	0.17	0.37	0.38	0.7	1.4	27	47	90	LQM / CIEH S4ULs
<i>Toluene</i>	130	290	660	880	1900	3900	55,600	11000	18000	LQM / CIEH S4ULs
<i>Ethylbenzene</i>	47	110	260	83	190	440	5,700	13000	27000	LQM / CIEH S4ULs
<i>Xylenes</i>	56	130	310	79	180	430	5,900	14000	30000	LQM / CIEH S4ULs
<i>Aliphatic C5-C6</i>	42	78	160	42	78	160	3200	5900	12000	LQM / CIEH S4ULs

Standard Land Use Scenario	Residential with Homegrown Produce			Residential without Homegrown Produce			Commercial			Source
<i>Aliphatic C6-C8</i>	100	230	530	100	230	530	7800	17000	40000	LQM / CIEH S4ULs
<i>Aliphatic C8-C10</i>	27	65	150	27	65	150	2000	4800	11000	LQM / CIEH S4ULs
<i>Aliphatic C10-C12</i>	130	330	760	130	330	770	9700	23000	47000	LQM / CIEH S4ULs
<i>Aliphatic C12-C16</i>	1100	2400	4300	1100	2400	4400	59000	82000	90000	LQM / CIEH S4ULs
<i>Aliphatic C16-C35</i>	65000	92000	110000	65000	92000	110000	1600000	1700000	1800000	LQM / CIEH S4ULs
<i>Aliphatic C35-44</i>	65000	92000	110000	65000	92000	110000	1600000	1700000	1800000	LQM / CIEH S4ULs
<i>Aromatic C5-C7</i>	70	140	300	370	690	1400	26000	46000	860000	LQM / CIEH S4ULs
<i>Aromatic C7-C8</i>	130	290	660	860	1800	3900	56000	110000	180000	LQM / CIEH S4ULs
<i>Aromatic C8-C10</i>	34	83	190	47	110	270	3500	8100	17000	LQM / CIEH S4ULs
<i>Aromatic C10-C12</i>	74	180	380	250	590	1200	16000	28000	34000	LQM / CIEH S4ULs
<i>Aromatic C12-C16</i>	140	330	660	1800	2300	2500	36000	37000	38000	LQM / CIEH S4ULs
<i>Aromatic C16-C21</i>	260	540	930	1900	1900	1900	28000	28000	28000	LQM / CIEH S4ULs
<i>Aromatic C21-C35</i>	1100	1500	1700	1900	1900	1900	28000	28000	28000	LQM / CIEH S4ULs
<i>Aromatic C35-C44</i>	1100	1500	1700	1900	1900	1900	28000	28000	28000	LQM / CIEH S4ULs
<i>Aromatic+aromatic EC>44-70</i>	1600	1800	1900	1900	1900	1900	28000	28000	28000	LQM / CIEH S4ULs
<i>Phenol</i>	280	550	1100	750	1300	2300	760	1500	3200	LQM / CIEH S4ULs
<i>Cyanide</i>	527			527			1400			CLEA 2009

Standard Land Use Scenario	Residential with Homegrown Produce	Residential without Homegrown Produce	Commercial	Source
PCBs	1.7	1.8	1.8	CLEA 2009

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Appendix C – Summary of Guidance Relating to Ground Gas

Summary of guidance relating to ground gas

In response to incidents of methane explosions in the mid 1980's guidance documents were produced in the UK for both planning authorities and the construction industry to allow safe development of sites located on or adjacent to gassing sites. There is a wealth of guidance and gas protection measures are now routinely included in engineering designs on gassing sites, eg former landfills, mineworkings, estuarine and fenlands and limestone or chalk areas.

The guidance does, however recognise that the risks posed by the presence of gas are not the same for all sites. The risk posed by the presence of gas in the ground below an actively generating recent domestic landfill is far greater than the negligible levels of risk that are posed by small pockets of material that are generating gas at very low levels. On sites such as former docklands, infilled ponds or reclaimed riverside or estuarine sites gas is generated very slowly from localised sources such as wood fragments or organic Alluvium deposits and is characterised by low volumes of gas generation and very low surface emission rates. Such sites have a long history of redevelopment for residential use without incidents from gassing ground (eg along the River Thames, London Docklands, a former landfill site in Warwickshire approved by the Environment Agency). As such they represent lower risk sites in terms of the presence of methane gas.

The type of development also needs to be taken into account in any assessment. Individual houses with gardens are the most sensitive development with flats being less sensitive and commercial and industrial developments being the least sensitive to the risks posed by gas in the ground.

The guidance and statutory requirements (Building Regulations) discussed below also recognises that the provision of gas protection measures is a valid method of mitigating the risks posed by the presence of gas in the ground. Indeed there are many thousands of both residential and commercial developments in the UK that have been constructed over gassing sites and that have been successfully provided with gas protection measures. Post construction gas monitoring on many of these sites has demonstrated that the protection measures are successful in preventing gas migration into the buildings.

Building Regulations

The Building Regulations Approved Document Part C 2011 requires that the risks posed by the presence of methane and carbon dioxide in the ground are assessed and appropriate protection measures provided. These latest amendments to the Building Regulations have moved away from specifying trigger concentrations and recommend that the risks are assessed and protection measures designed in accordance with Environment Agency and CIRIA guidance.

This report follows the guidance in the Building Regulations by assessing the risks posed by the presence of the gas and providing recommendations on suitable protection measures.

The Building Regulations also emphasise the need to measure borehole emission rates so that the gas generation and migration potential can be assessed. The investigation data together with the gas monitoring undertaken by Clarkebond and NX Consulting satisfies these requirements.

CIRIA

The Construction Industry Research and Information Association (CIRIA) provides comprehensive guidance in a series of guidance documents relating to the construction of new developments over sites where methane is present.

The most recent guidance from CIRIA was published in 2007. In summary the CIRIA guidance recommends that the provision of gas protection measures should be based on a comprehensive desk study, ground investigation and gas monitoring, including measurement of borehole flow rates. This will help identify ground conditions, potential sources of gas, migration pathways and

generation potential. The level of risk may then be assessed and an appropriate gas protection system designed. Account should also be taken of the sensitivity of the proposed end use.

The latest CIRIA guidance incorporates the risk assessment method proposed by Wilson and Card. Table 1.2 summarises the method for characterising gassing sites for developments other than low rise housing, using the gas screening value (borehole flow rate x gas concentration) in addition to total gas concentrations.

Table 1.2 - Modified Wilson and Card classification, (CIRIA 2007)

Characteristic Situation (CIRIA 149)	Gas screening value (l/hr) ¹	Additional limiting factors	Typical source of generation
1	<0.07	Typically methane not to exceed 1% by volume and carbon dioxide not to exceed 5% by volume otherwise consider increase to Situation 2	Natural soils with low organic content "typical" Made Ground
2	<0.7	Borehole air flow rate not to exceed 70l/hr otherwise consider increase to characteristic situation 3	Natural soil, high peat/organic content "typical" Made Ground
3	<3.5		Old landfill, inert waste, mine working flooded
4	<15	Quantitative risk assessment required to evaluate scope of protection measures.	Mine working – susceptible to flooding, completed landfill, inert waste (WMP 26B criteria)
5	<70		Mine working unflooded inactive with shallow workings near surface
6	>70		Recent landfill site

In addition use of the table requires sufficient gas monitoring data as shown in Table 1.3.

Table 1.3 Typical minimum periods and frequency of monitoring (CIRIA 2007)

		Generation potential of source				
		Very low	Low	Moderate	High	Very high
Sensitivity of development	Low	4/1	6/2	6/3	12/6	12/12
	Moderate	6/2	6/3	9/6	12/12	24/24
	High	6/3	9/6	12/6	24/12 ³	24/24 ³

Notes

1. First number is minimum number of readings and second number is minimum period, for example 4/1 – Four sets of readings over 1 month

2. At least two sets of readings must be at low and falling atmospheric pressure (<1000mb)
3. The acceptability of placing high sensitivity end use on a high gas hazard site is not normally acceptable unless source is removed or treated to reduce gassing potential

There are many techniques to protect development from methane and associated gases Card (1993). Each measure has its own advantages and disadvantages and may be more suitable in certain situations and types of development. Furthermore no protective measure on its own is immune from factors unknown to or out of the control of the designer. Such factors might lead to failure and for this reason it is normal practice to combine individual protection measures to form a gas control system. In this way the probability of failure or of gas passing each individual protection measure in the system is minimised.

CIRIA Report 665 reflects current building industry practice more closely than Waste Management Paper 27 and ICRCL Guidance Note 17/78 (last updated in 1990) with regard to development on gassing sites.

Construction (Design and Management) Regulations

The presence of the gas in the ground poses a potential risk to the development. Under the requirements of the Construction (Design and Management) Regulations, 1994, this risk should be designed out to minimise risks to the occupiers.

Partners in Technology

At the time of preparing CIRIA Report 149 borehole flow rates were generally not capable of being measured with great accuracy, therefore the requirement for assessing the gas regime based on the maximum parameter was adopted. However, the standard of measuring gas concentrations and particularly borehole flow rates has improved greatly in recent years. This is due to environmental legislation associated with the waste management industry and the requirements of WMP 26A for landfill completion. It is now standard practice to assess gas regimes on the basis of the volumes of gas flowing from the ground, i.e. a combination of the gas concentrations and borehole flow rates. This principal is used in the DETR/ Partners in Technology report, *Passive venting of soil gases beneath buildings*, which considers both concentrations and flow rates to define characteristic gas situations, although these were not meant to be used to classify sites, but merely to define a set of specific design situations.

The Partners in Technology Research Report also provides criteria for the assessment of passive underfloor ventilation systems. For methane a passive ventilation system is deemed to have very good performance characteristics when the equilibrium concentrations of methane are maintained below 1% by volume in air at wind speeds of 0.3 m/s and 3 m/s (at the height of the vents).