



**BROWNFIELD
SOLUTIONS LTD**

GEO-ENVIRONMENTAL ENGINEERING EXCELLENCE

DOMIS CONSTRUCTION LTD

Victoria House, Great Ancoats Street, Manchester

Piling Risk Assessment

JM/C4742/10386

August 2021

PROJECT QUALITY CONTROL DATA SHEET

Site Name:	Victoria House, Great Ancoats Street, Manchester		
Document Name:	Piling Risk Assessment		
Reference:	JM/C4742/10386		
Status:	-	24/08/2021	Final.

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DRAWINGS

Drawing Number	Rev	Title
10122-A-B5D9-G200-P-00-003	-	Proposed Ground Floor Plan
10122-A-B5D9-G200-P-B1-003	-	Proposed Basement Plan
C4742/01	-	Site Location Plan

1.0 INTRODUCTION

1.1 Context and Objective

This report describes a Piling Risk Assessment produced by Brownfield Solutions Limited (BSL) for Domis Construction Ltd on a site off Great Ancoats Street, Manchester.

This assessment has been completed in general accordance with the following guidance:

- Environment Agency (EA) Document NC/99/73, "Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention".
- Environment Agency (EA) Document, National Groundwater and Contaminated Land Centre, Piling into Contaminated Sites, February 2002.

The objective of this assessment is to determine the suitability of driven pile foundations for the proposed development.

The proposed piling solution has the potential to create a pathway for contamination to migrate through the made ground and into the natural strata and groundwater. As such, these activities are carried forward only after an assessment of the impact of works in this report have been undertaken.

1.2 Proposed Development

The proposed development is for a part 25 storey, part 3 storey residential tower with ground floor commercial space above partial basement level (north-west corner) and associated hard / soft landscaping as shown on the Proposed Ground Floor Development Plan, drawing No. 10122-A-B5D9-G200-9-00-003 provided to BSL by the client.

1.3 Previous Reports

This risk assessment follows the completion of the following reports, which should be read in conjunction with this assessment:

- BSL, Desk Study Assessment Report, reference NS/C4742/10165, dated June 2021.
- BSL, Geo-Environmental Assessment Report, reference JM/C4742/10165 Rev A, dated July 2021.

1.4 Limitations

The findings and opinions conveyed via this assessment are based on information obtained from a number of sources as detailed within this report, BSL have assumed this information is correct and reliable. Nevertheless, BSL cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

BSL have used all reasonable care and skill in the production of this report. There may be other conditions prevailing on the site which are outside the scope of work and have not been highlighted by this assessment and therefore have not been taken into account by this report. Responsibility cannot be accepted for such site conditions not revealed by the assessment.

This report has been prepared for the sole use and reliance of the Client, Domis Construction Ltd. No other third parties may rely upon or reproduce the contents of this report without the written permission of Brownfield Solutions Ltd (BSL). If any unauthorised third party comes into possession of this report, they rely on it at their own risk and BSL do not owe them any Duty of Care.

Any recommendations made in this report should be confirmed with the Regulatory Authorities prior to implementation to ensure compliance.

This assessment has been based on the proposed planning layouts provided. Any subsequent change to the planning layout may have an impact on the validity of recommendations made within this report. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

2.0 GROUND MODEL SUMMARY

2.1 Description of Site

The site is located off Great Ancoats Street, Manchester, M4 7DB. It is situated within Manchester City Centre inner ring road, centred on National Grid Reference 385314, 398073 as shown on the Site Location Plan, Drawing No. C4742/01.

The main site features and potential issues identified prior to construction commencing at the site are detailed below.

Feature	Description
Site Area	The site is approximately 0.13 hectares.
Site Access	The site operates a one way system for vehicular access, access is therefore gained from Epworth Street to the south-east. Egress is onto Longacre Street to the north-west. Pedestrian access to the building is available from Great Ancoats Street to the north.
Current Land Use and Site Features	The site currently comprises a singular three storey brick building in the east with adjoining steel framed warehouse to the west. Associated car parking is present across the southern half of the site. The brick structure is utilised to house office space and meeting rooms, the warehouse is utilised for storage of valuables with vaults as part of The Manchester Safe Deposit Centre.
Potential Sources of Gross Contamination	No significant sources of contamination were identified onsite.
Vegetation	No vegetation is present within the site boundary.
Topography	The site is relatively flat, with a slight incline from Longacre Street to the west towards Epworth Street to the east.
Site Boundaries	The north-east of the site is enclosed by a brick wall with metal rails, a small metal pedestrian gate is present in the easternmost corner. The south-eastern site boundary is bound by a brick wall with metal rails, the eastern brick building gable end and a large electronic metal gate for vehicular access. The southernmost site boundary comprises the gable end of an adjacent warehouse, a gravel board fence, and a brick wall with metal fencing above. The north-western boundary is demarked by a brick wall, large electronic metal gate, the western gable end of the steel frame warehouse and a brick wall with metal railing.
Surrounding Area	The site is set within a mixed commercial and residential area, bordered by residential apartments to the west, Great Ancoats Street to the north / east with residential apartment buildings beyond. To the south-east of the site is an active construction site for a proposed hotel, and to the south is a warehouse and derelict brownfield land.

2.2 Environmental Setting

History

The earliest maps indicate the site to have been developed as a timber yard with associated chimney, and a row of terraced properties present along the south-eastern boundary. A warehouse, recorded as Victoria House, first appeared in 1967 and extended across to the west of the site in 1989, remaining at present day. All other original buildings disappeared from mapping by 1971.

Geology

Made ground was encountered within all the exploratory holes across the site and was observed from ground level to depths between 2.00m and 2.85m bgl.

Hardstanding surfacing of tarmacadam was present across the majority of the site recorded as being 0.15m thick. A concrete slab up to 0.45m thick was encountered in the west corner of the site, protruding out the ground.

The composition of the made ground beneath the hardstanding was fairly consistent across the site and represented demolition material comprising gravelly sand with varying amounts of ash as a minor constituent. Gravel and cobbles of brick and sandstone ranged from low to medium content.

The natural strata underlying the site was generally a firm to stiff clay with varying amounts of sand and gravel as minor constituents. This is interpreted to represent Glacial Till. The gravel was generally subangular to angular fine to coarse of sandstone.

This was underlain by a dense clayey slightly gravelly sand with pockets of sandy clay encountered from 10.00m to 12.00m bgl down to the bedrock. SPTs regularly refused in this strata, with N values of 50.

A thin band of dense sand and gravel with a low sandstone cobble content was encountered in BH1 from 12.00m to 13.51m bgl. The sand was fine to coarse and the gravel was subrounded to angular fine to coarse of sandstone.

Extremely weak brownish red fine to coarse sandstone bedrock was encountered from depths of between 17.50m and 18.00m bgl. This was proven to a maximum depth of 33.00m across the site and is interpreted to represent the Chester Formation. Discontinuities were generally very closely spaced to closely spaced, rough, undulating and sub-horizontal.

Hydrogeology

The superficial deposits (Devensian Till) in this area are classified by the Environment Agency as a Secondary Undifferentiated Aquifer. The classification is assigned where it is not possible to attribute either category A or B to the aquifer.

The bedrock (Chester Formation) is classified as a Principal Aquifer. These are defined as layers of rock that have high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

There are no source protection zones indicated to lie within 500m of the site.

The soils on site are indicated to have a low leaching potential, described as soils which can possibly transmit a wide range of pollutants.

During the site investigation groundwater was not encountered. Post site works monitoring recorded groundwater ranging from 1.49 to 22.08m bgl, which is likely to represent perched groundwater.

Hydrology

The nearest surface water feature to the site is the Ashton Canal and Peak Forest Canal approximately 70m to the north-west. The nearest watercourse to the site is the River Medlock which lies 278m to the south-east.

There are no surface water abstractions within 2000m of the site.

2.3 Summary of Risk Assessments

The ground investigations have confirmed the following:

- Trace levels of asbestos (loose fibres) within the made ground soils at two locations.
- Slightly elevated concentrations of carbon dioxide were encountered during the gas monitoring, this is considered to be attributed to microbial activity and the site is therefore classified as Characteristic Situation 1 and no gas protection measures are required.
- Elevated concentrations of lead were encountered within the made ground.

Human Health Risks

Elevated concentrations of lead were encountered within the made ground. Trace levels of asbestos were located in two samples. Proposed development plans indicate that the site is to be present with either hardstanding or building footprint across the majority of the site. In addition, the soils where asbestos was identified in WS05 are to be removed for the construction of a new basement. The creation of a circa 600mm piling mat will also break the pathway between the potentially contaminated site soils and the end-user.

Any of soft landscaping, currently indicated to be small in size and located around the perimeter, will require a cover system.

Ground Gas

Elevated levels of carbon dioxide were recorded across the site. The peak carbon dioxide concentrations ranged from 0.1%v/v to 5.0%v/v. Steady state values ranged from 0.1%v/v to 5.1%v/v. Positive flows ranged between 0.0l/hr and 1.0l/hr. These slightly elevated levels of carbon dioxide are considered to be attributed to microbial activity and the site is therefore classified as Characteristic Situation 1 and no gas protection measures are required.

Risk to Controlled Waters

Whilst there are elevated concentrations of contaminants, based on the investigation works undertaken to date and subject to agreement with the Environment Agency, the site is not considered to pose a significant risk to controlled water for the following reasons:

- The EQS for lead are also based on bioavailability and so this risk assessment is conservative as it assumes 100% bioavailability.
- There is no indication under present conditions of pollution of controlled waters and conditions following development of the site will not be any worse, indeed they may improve with increased hard cover and water retaining imported garden soils.
- The concentrations of leachable substances that could emanate from the site will be subject to dilution and dispersal during transport and so the risks will reduce with distance from the site and into the identified surrounding water bodies.
- It would be technically challenging and probably disproportionately costly to remove the contaminants from the water to the pre-input stage.
- No significant contamination has been identified on site in soils based on the results obtained as a potential indicator of groundwater contamination.
- The nearest watercourse is over 250m away, which provides considerable distance for attenuation and contaminant degradation.
- The site is underlain by low permeability clays which will inhibit lateral and vertical contaminant migration.
- The site does not lie within 500m of an SPZ.
- There are no groundwater abstractions within 1500m.
- There are no potable (sensitive) water abstractions within 2000m.

Outcome of Risk Assessments

In respect to controlled waters, it is considered contaminants associated with the made ground and other past industrial uses are unlikely to impact the River Medlock.

There are no potable water abstraction licences or Source Protection Zones near the site. As stated above, the site is currently surfaced in hardstanding and will remain so, with a new surface water drainage system installed which will further reduce the risk to controlled waters. Further to this, a thickness of low permeability deposits underlies the made ground which will inhibit vertical migration. The risk to the principal aquifer is considered to be low.

Generally elevated concentrations of heavy metals and asbestos are not considered to be a viable source of contamination and no relevant pathways have been identified onsite due to the presence of hardstanding and building footprint proposed for the extents of the site, therefore no specific remedial measures are required for heavy metal contaminated soils in respect to human health risk via dermal contact and ingestion for the proposed end use, except for any small areas of soft landscaping as proposed around the perimeter.

2.4 Proposed Works and Foundation Options

Due to the likely magnitude of the column loads expected to be imposed by the proposed multi-storey structure, from a geotechnical perspective the most suitable foundation solution is considered to be piles. The piled foundations should be found on the sandstone bedrock encountered from between approximately 17.50m and 33.00m bgl.

It is understood that continuous flight auger piles socketed into the sandstone bedrock are the preferred method of pile emplacement for the site. These are considered to be penetrative works for the purpose of this Risk Assessment.

These piles are formed by rotating a hollow stem continuous flight auger into the soil to the required depth, the pumping concrete in to fill the cavity as the auger is removed. Reinforcement will then be added as required. The existing ground materials will be excavated by the auger and will require disposal. It will also be necessary to remove made ground soils in the vicinity of the structure in order to accommodate a working platform for the piling rig, and also for the construction of a new basement, thus removing part of the source of potential contamination.

As part of the development, the made ground will be covered with hardstanding and a new drainage system. The drainage system, whilst utilising permeable paving, will be lined with an impermeable membrane in order to inhibit infiltration. This will significantly reduce the amount of infiltration available and the propensity for the generation of contaminated leachate from the site.

3.0 PILING RISK ASSESSMENT

3.1 Introduction

The risks associated with piling and ground improvement works must be considered on a site-specific basis and the potential receptors are defined by the hydrogeological properties of the strata underlying the site, the proximity of other receptors along with the site history, current use and surroundings. The Environment Agency indicate that concerns about water protection are likely to be most severe when:

- Contaminants are present on the site and ground works could allow them to migrate.
- Piling would breach an aquitard or connect two previously discrete aquifers.
- The site overlies a Principal or a Secondary A Aquifer.
- The site is located within a Source Protection Zone (SPZ).
- Groundwater is currently of good quality.
- The water table is shallow or likely to be intersected by piles.
- The geological strata are fractured or fissured.
- Works are close to a surface water body and run-off from arisings could pollute those waters.

This risk assessment takes into consideration the current guidance on Pollution Prevention and the source-pathway-receptor (S-P-R) approach. There are six possible generic pollution linkages considered by the Environment Agency to be created by piling and these are:

1. Creation of permeable pathways through a low permeability layer to allow potential contamination of an underlying aquifer.
2. Creation of preferential pathways, through a low permeability surface layer, to allow upward migration of land gas, soil gas or contaminant vapours to the surface.
3. Direct contact of site workers or others with contaminated soil arisings which have been brought to the surface.
4. Direct contact of the piles or engineered structures with contaminated soil or leachate causing degradation of pile materials (where the secondary effects are to increase the potential for contaminant migration).
5. The driving down of contaminants down into the aquifer during pile driving.
6. Contamination of groundwater, and subsequently surface waters, by concrete, cement paste or grout.

3.2 Sources of Contamination

With relevance to pile installation and this assessment, the contaminants identified within the made ground are considered to be the main potential source of contamination, where elevated concentrations of lead and trace fibres of asbestos have been identified.

No specific remedial action was recommended for these contaminants based on the rationale summarised in Section 2.3.

3.3 Ground Gas

Slightly elevated concentrations of carbon dioxide were recorded during ground gas monitoring. However, this is considered to be attributed to microbial activity and the site is therefore classified as Characteristic Situation 1 and no gas protection measures are required.

3.4 Pathways

The contaminants identified above are considered to present potential risks to controlled waters through the following pathways:

- Leaching of mobile contamination into groundwater.
- Migration of perched groundwater in any permeable soils or along existing or proposed service runs.
- Saturated zone flow through the made ground underlying the site.
- The installation of piles resulting in the creation of a preferential pathway.

3.5 Receptors

The relevant sensitive receptors include:

- River Medlock 278m south-east of site.
- Groundwater within the superficial (Devensian Till Deposits) Secondary Undifferentiated Aquifer.
- Groundwater within the Principal Aquifer of the Chester Formation.
- Construction workers.
- Site end-users.
- The fabric of the piles.

3.6 Risk Assessment

Each of the relationships described above are qualitatively assessed with relation to the six specific scenarios detailed in the table overleaf. Any assessed risk that is above moderate/low will possibly require further action.

Pollution Scenario	Activity	Source	Pathway	Receptor	Likelihood	Consequence	Risk	Justification
Scenario 1 Creation of permeable pathways through a low permeability layer to allow potential contamination of an underlying aquifer	Installation of deep foundations (piles)	Lead and trace asbestos fibres within made ground	Migration via disturbed zone adjacent to installed piles	Controlled Waters	Unlikely	Medium	Low	No significant sources of mobile contamination have been identified. Elevated heavy metals and trace asbestos within made ground will largely be removed when site levels are reduced to accommodate a piling mat, basement construction and concrete slab build up. The site is proposed to be building footprint for the majority with hardstanding present across the remainder of the site which will reduce the potential for leaching and lateral migration. The pile itself will be formed from wet concrete and will form a good seal against the surrounding strata. When the concrete is set, there should be no additional significant pathway created. The migration of contaminants from the made ground is also considered to be largely restricted by the predominantly impermeable nature of the superficial deposits and therefore not pose a risk to the other water bodies. The creation of a pathway through the clays by the piles is not considered likely provided the piles are installed correctly. If the creation of pathways was occurring, then the pile would not be working correctly from a geotechnical perspective, causing potential structural issues for the proposed multi-storey development.

Pollution Scenario	Activity	Source	Pathway	Receptor	Likelihood	Consequence	Risk	Justification
								Furthermore, the location of the piles will be within the footprint of the proposed building, with a large concrete slab which will also benefit from newly installed drainage, drastically reducing the amount of water infiltrating the made ground and reducing the possibility of contaminated water reaching the piles.
Scenario 2 Migration of vapours	CFA Piles	Ground gas generated from degradable matter within the made ground	Migration via disturbed zone adjacent to installed piles	Site end-users / Confined spaces within buildings	Unlikely	Severe	Moderate /low	Ground gas does not pose a risk to site end users and structures based on the results of the gas monitoring programme. Latest research suggests that even if a preferential pathway could develop, the influence on the gas risk will depend on the number of piles, gas pressure and horizontal permeability. A significant effect is possible only where gas is under pressure and/or the piles are very closely spaced. However, in this case, ground gas protective measures are not considered to be required. Continuous gas monitoring next to piling rigs during emplacement is advisable to alert warn construction workers should any unidentified gas generating strata be encountered.
Scenario 3 Contact (dermal contact, dust inhalation, accidental ingestion) between Site Workers and	CFA Piles	Lead and trace asbestos fibres within made ground	Potential contact via dermal pathways	Construction Workers	Unlikely	Medium	Low	Soil arisings will be generated due to the proposed piling solution. The risk from made ground will be mitigated by standard PPE including gloves. An Asbestos Management Plan for the site when implemented and suitable RPE provided will mitigate any risk from

Pollution Scenario	Activity	Source	Pathway	Receptor	Likelihood	Consequence	Risk	Justification
contaminants in pile arisings								asbestos. Welfare facilities should be made available to wash before hand to mouth activities. General guidance on these matters is given in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land".
Scenario 4 Degradation of pile materials via sulphate attack thereby increasing contaminant mobility	Installation of deep foundations (piles)	Heavy metals, and sulphates within made ground and sulphates within natural strata	Via zone of degradation next to pile	Groundwater beneath the site	Unlikely	Medium	Low	Degradation of pile materials via sulphate attack would likely increase contaminant mobility, leading to increased contaminant migration. However, the appropriate design concrete class will be adopted in accordance with BRE Special Digest 1 to mitigate against this, minimising the risk of degradation of pile materials.
Scenario 5 Driving down solid Contaminants	CFA Piles	Lead and trace asbestos fibres within made ground	Leaching of contaminants in soils driven down during installation of piles	Groundwater beneath the site	Unlikely	Medium	Low	The selected method will bring arisings to the surface, therefore it is not envisaged any made ground materials (solid contaminants) will be driven down into the underlying strata.
Scenario 6 Contamination of groundwater by concrete, cement paste or grout	CFA piles	'Dry' cured concrete used – pre-cast concrete tubes and tubular steel piles	Contact with groundwater and off-site flow in aquifer	Groundwater beneath the site	Unlikely	Medium	Low	The rotary technique employs the use of wet concrete; however this will likely go off within a very short duration of time, thereafter inhibiting groundwater flow. In addition to this, concrete will be poured within casing which reduces the ability for concrete to migrate and therefore not considered to pose a significant risk to controlled waters.

4.0 CONCLUSIONS

The proposed piling method at the site is rotary bored piles founded on the sandstone bedrock. The risk assessment carried out demonstrates overall risks to the identified receptors associated with the chosen piling methods are considered to be low/moderate to low in accordance with the Environment Agency's Piling Risk Assessment methodology.

Pollution Scenario	Level of Risk
Scenario 1	Low
Scenario 2	Low/Moderate
Scenario 3	Low
Scenario 4	Low
Scenario 5	Low
Scenario 6	Low

Due to the low risk at the site the use of specific mitigation measures are not considered necessary in respect of controlled waters, site end users and construction workers. The evidence in this assessment should be provided to satisfy the regulatory authorities. Should a change in piling methodology be proposed then this risk assessment would need to be revised accordingly.

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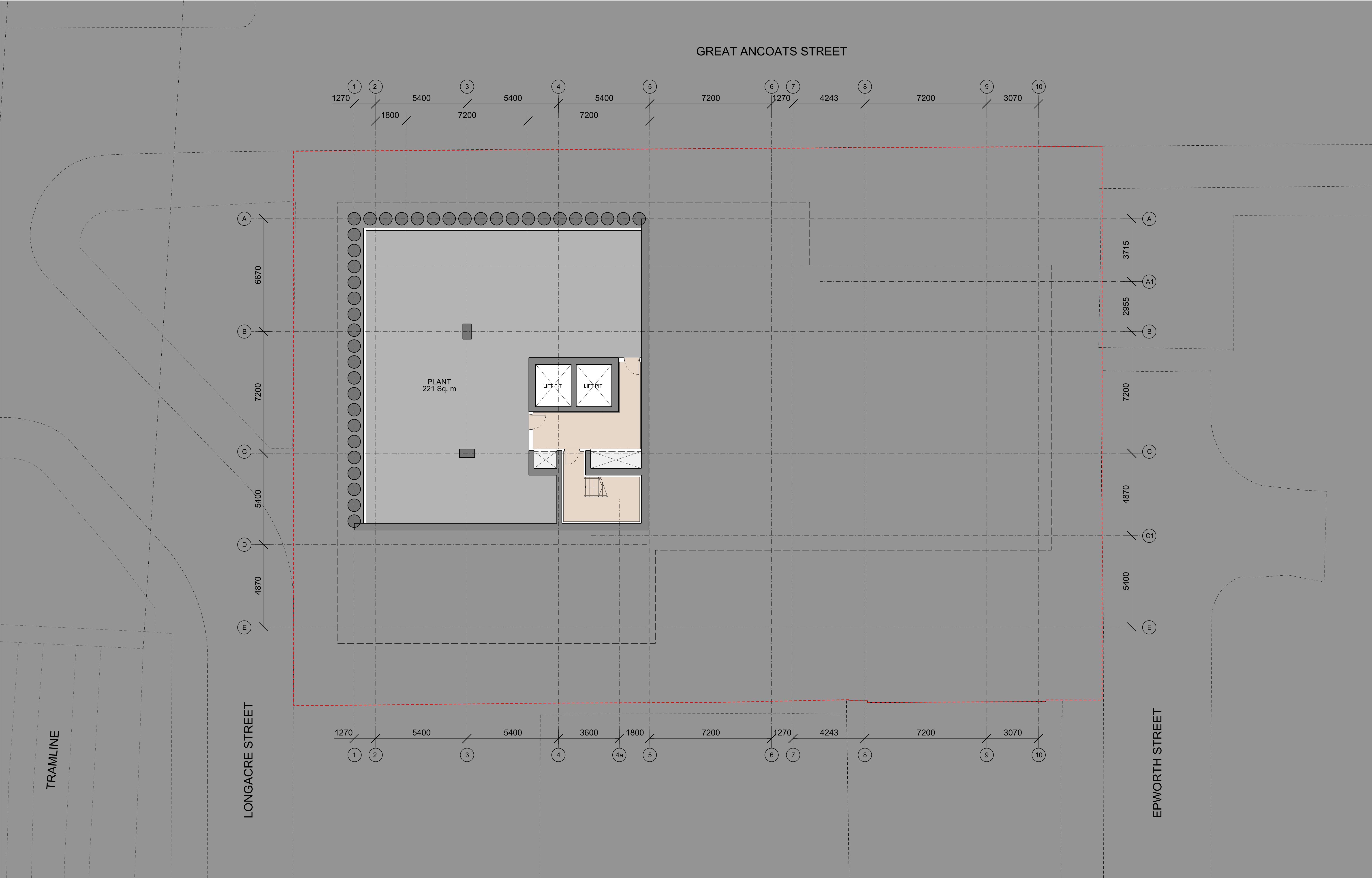
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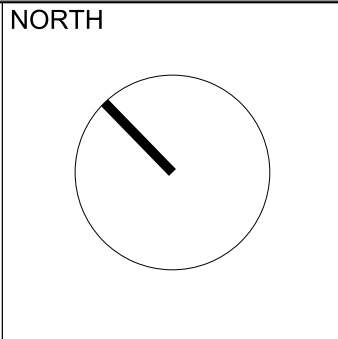
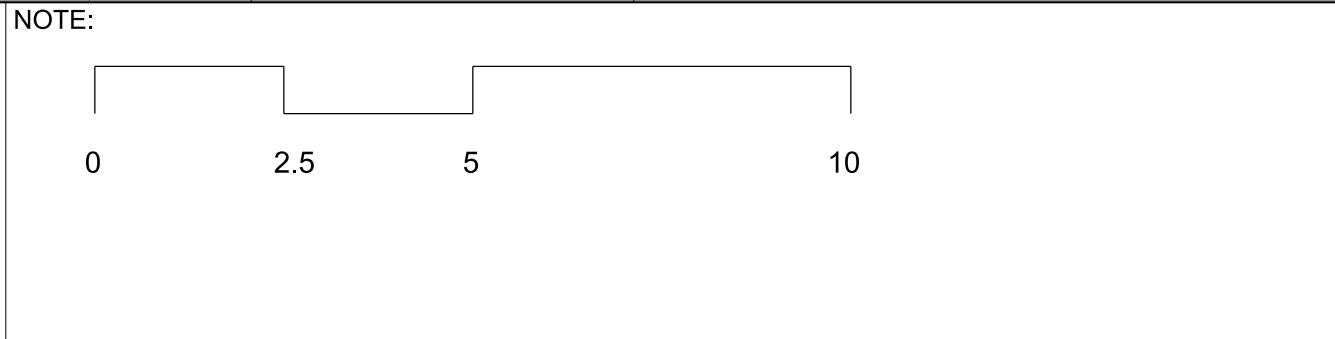
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Rev	Date	Description
00	18-02-2020	Planning Issue

Project Title
VICTORIA HOUSE

Status
FOR PLANNING

Drawing Title		
BASEMENT PLAN		
Job No 10122	Scale 1:100 @ A1	Date FEB 2020
Drawing No 10122-A-B5D9-G200-P-B1-003	Revision 00	

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Rev	Date	Description
00	18-02-2020	Planning Issue

Project Title
VICTORIA HOUSE

Status
FOR PLANNING

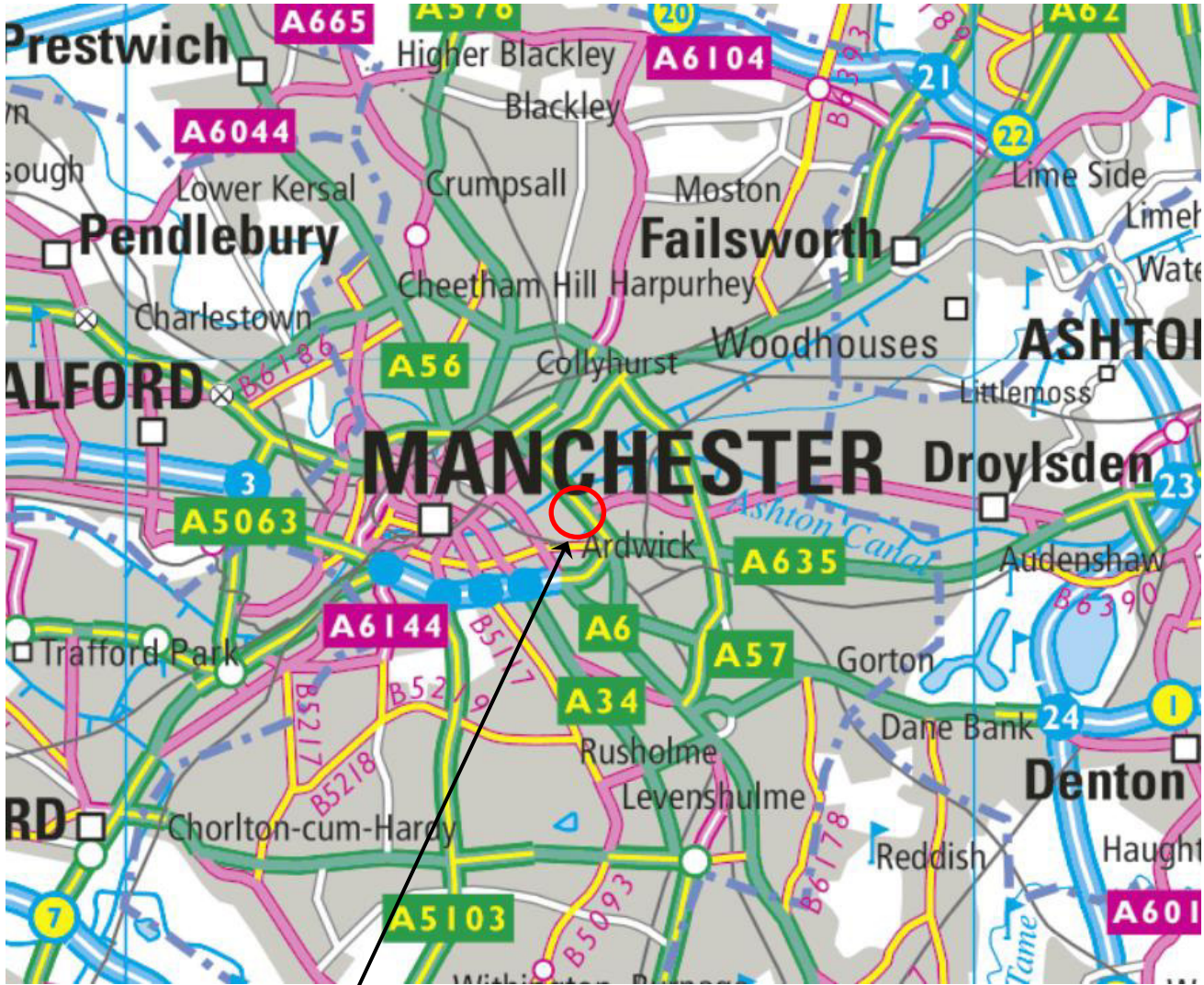
Drawing Title
GROUND FLOOR PLAN

Job No 10122	Scale 1:100 @ A1	Date FEB 2020
Drawing No 10122-A-B5D9-G200-P-00-003	Revision 00	

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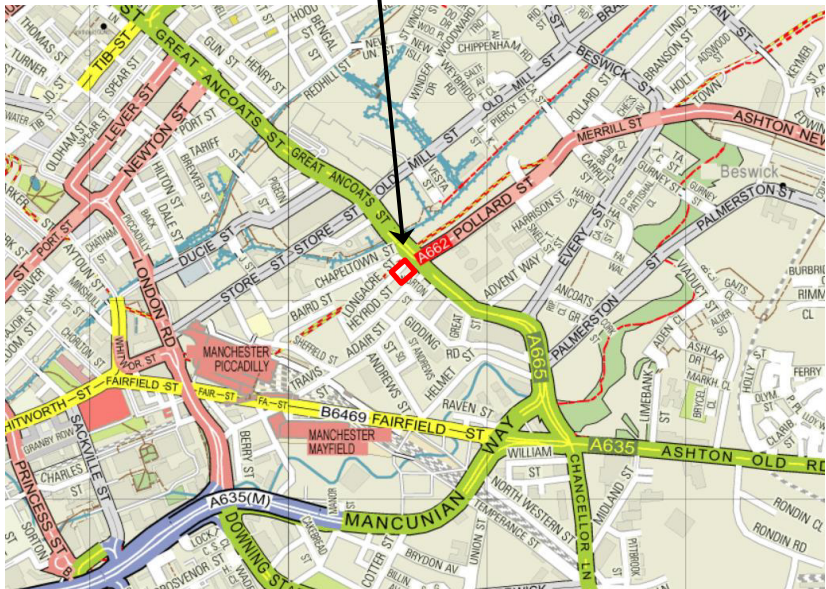
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SITE LOCATION

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REV	DATE	DESCRIPTION	BY	CKD
 BROWNFIELD SOLUTIONS LTD CEO ENVIRONMENTAL ENGINEERING EXCELLENCE				
CLIENT DOMIS CONSTRUCTION				
PROJECT TITLE VICTORIA HOUSE, GREAT ANCOAT STREET				
DRAWING TITLE SITE LOCATION PLAN				
DRAWING No. C4742/01		REVISION -	SCALE NTS	DATE 22/04/21
DRAWN BY SD			CHECKED BY DMG	