Fusion Manchester Devco Ltd

Deansgate, Manchester

Foundation Works Risk Assessment

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Deansgate, Manchester

Foundation Works Risk Assessment

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			Claire Hooley	Ruth Easterbrook	Claire Hooley
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1 INTRODUCTION

1.1 Terms of Reference

1.1.1 TEC has been appointed by Rhomco on behalf of Fusion Manchester Devco Ltd to prepare a Foundation Works Risk Assessment (FWRA) for the proposed piled foundations at Deansgate, Manchester. All works were undertaken in accordance with our proposal email dated 11 July 2023.

1.2 Background

1.2.1 The site is a roughly triangular shaped plot of disused land located off the junction between Deansgate and the A56 Bridgewater Viaduct in the southwest of Manchester City centre (Figure 1). It is approximately 0.06ha in size, with the centre of the site located at approximate National Grid Reference SJ 83294 97433. The nearest postcode is M15 4TP.

1.2.2 The proposed development is understood to comprise the construction of 534No purpose-built Student Accommodation units, within a 28-storey building (Corstophine & Wright Drawing No. 20269-0310 'Proposed – Plan – Lower Ground Floor'). The triangular building footprint will cover the majority of the development site, with a substantial lower ground floor (basement) level, accessed from Deansgate South.

1.2.3 In order to retain the adjacent highways/footpaths so that the site can be safely excavated and building foundations installed, a contiguous piled wall is required. The contiguous pile wall is formed from 750mm diameter CFA reinforced concrete piles that will match the profile and installation of the remaining building piles.

1.2.4 Across the whole site, it is proposed to reduce site levels by 5.8m to facilitate the enabling works and construction of the lower ground floor level, as detailed within the General Arrangement Foundation Sections for the site (reference DSM-SDL-ZZ-FX-DR-ST-0091 P03 and DSM-SDL-ZZ-FX-DR-ST-0092 P03). This, together with the removal of the former petrol filling station infrastructure and further contaminant hotspots identified, will remove the gross contamination source from site. This will result in significant betterment in groundwater quality, following completion of the remediation works.

1.2.5 It is understood that a planning application (Ref: 129406/FO/2021) has been submitted to Manchester City Council, with an appeal decision (ref: APP/B4215/W/21/3287525) granting full planning permission for the proposed development. The Schedule of Conditions for Planning Permission 129406/FO/2021, contained within the Appeal Decision includes Condition 5, which states:

> *"Prior to the commencement of development (other than demolition and site clearance), details of piling using penetrative methods shall not be carried out other than with the written approval of the local planning authority. Development shall be carried out in accordance with the approved details."*

1.2.6 This document has been produced to address the above condition.

Previous Reporting

1.2.7 The following TEC reports have been prepared for the proposed development, as detailed within the following reports:

- Deansgate, Manchester – Ground Investigation Report. Prepared for Manchester Devco Ltd, referenced 2006023.001.01C dated October 2022 and revised October 2023
- Deansgate, Manchester – Remediation Strategy and Verification Plan. Prepared for Fusion Devco Ltd, referenced 2006023.004.01C dated September 2023 and revised November 2023

1.2.8 In addition, a number of previous assessments have been undertaken for the site, which were provided to TEC by the Client, and reviewed as part of the Ground Investigation Report detailed above. The reports provided for review are detailed below:

- Deansgate South, Manchester: Phase I (Desk Study) Investigation Report by Opus. Report ref: J-W0501.02 prepared for Knott Mill Securities Ltd.
- Deansgate South, Manchester: Phase I Preliminary Risk Assessment Report by WSP. Report ref: 11742(1) prepared for Fusion Manchester Devco Ltd.

- Deansgate South, Manchester: Factual Report on Ground Investigation by Structural Soils Ltd. Report ref: 764121 prepared for Buro Happold Engineering.

1.2.9 As part of the enabling and site preparation works for the site, remediation and subsequent validation has commenced on site, under the supervision of Brownfield Solutions Ltd (BSL). The remediation works is currently in progress, although not yet completed, with interim validation for works completed to date reported within the following document:

- Fusion, Manchester – Remediation Validation Report by BSL. Reported reference NS/C5511/12505 and dated October 2023. Report prepared for Domis Construction Ltd

1.2.10 It is assumed these previous reports can be relied upon, although TEC hold no responsibility for the validity of third-party information.

1.2.11 While the salient information from these reports has been summarised within the following sections, reference should be made to the above reports for full details.

1.3 Scope of Works

1.3.1 The aim of these works is to provide information on the foundation designs and constraints associated with the site with regard to the proposed development.

1.3.2 The scope of work undertaken as part of this FWRA report is presented below:

- Review of the existing geoenvironmental and geotechnical data pertaining to the site and its surroundings;
- Development of the understanding on potential contaminant migration pathways;
- Development of a suitable rationale behind the foundation selection;
- Risk assessment to justify the foundation selection;
- Description of the mitigation measures necessary for the identified risks; and
- Provision of monitoring considered necessary during and post the construction works.

1.4 Methodology

1.4.1 The methodology is outlined by the recommendations made by the Environment Agency's Report titled "*Piling into Contaminated Sites*", February 2002 and the National Groundwater and Contaminated Land Centre Report NC/99/73:"*Piling and penetrative ground improvement methods on land affected by contamination: Guidance on pollution prevention*" within which, six possible contamination pathways are identified by the Environment Agency. These six contamination scenarios are refined, to incorporate the site-specific conceptual model and a piling methodology will be chosen that mitigates the possible contamination pathways and fits with the scope of the development.

1.4.2 The FWRA therefore considers the:

- Creation of preferential pathways (breaching of impermeable layers), allowing contamination to migrate and impact the underlying aquifer or allowing gas to migrate upwards posing a risk to the proposed structures;
- Breaching of impermeable layers, allowing contamination to migrate and impact the underlying aquifer or allowing gas to migrate upwards posing a risk to the proposed structures;
- Risks associated with the piling method, i.e. potentially driving made ground and potentially contaminated materials downwards into the underlying natural strata during pile construction;
- Generation of contaminated soil arisings posing a risk to human health;
- Disposal requirements of soil arisings;
- Effects of aggressive ground conditions on buried concrete;
- Effects of the piling method on the surrounding environment; and
- Potential for contamination of surface and groundwater from pile construction materials.

1.5 Limitations

1.5.1 The findings and opinions conveyed via this assessment are based on information obtained from a number of sources as detailed within this report, TEC have assumed this information is correct and may be relied upon.

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

1.5.3 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 DATA REVIEW

2.1 Site Location and Description

2.1.1 The site is located off the junction between Deansgate and the A56 Bridgewater Viaduct in the southwest of Manchester City centre. The site is approximately 0.06ha in size, with the centre of the site located at approximate National Grid Reference SJ 83294 97433. The nearest postcode is M15 4TP.

2.1.2 During the site reconnaissance survey undertaken in August 2022, the site was observed to comprise a triangular shaped plot of disused land covered entirely with concrete hardstanding, although areas of scrub vegetation were noted as present in areas where the slab had been damaged.

2.1.3 The site was bordered by wooden hoarding on all sides except for the north-eastern perimeter, where a brick built retaining structure was present. In the northern corner of site, a section of brick wall that appeared to be the remnants of a historical structure, as evidenced by blocked windows and vents, bridged over a small section of the adjacent access road just off site and ran southeast into the site by approximately five metres.

2.1.4 Access to the site was obtained through a gate in the western corner of the hoarding off Deansgate Road near the junction with the A56.

2.2 Proposed Development

2.2.1 The proposed development is understood to comprise the construction of 534No. Purpose Built Student Accommodation units within a 28-storey building taking up virtually the whole site and including a lower ground floor level, accessed from Deansgate South, providing ancillary accommodation, a ground floor accommodating reception and office space, lounge, social and game spaces, a laundry, and a first floor level gym, wellbeing suite and communal study space.

2.2.2 Across the whole site, it is proposed to reduce site levels by 5.8m to facilitate the enabling works and construction of the lower ground floor level.

2.3 Site History

2.3.1 Earliest available mapping reportedly recorded the site as forming park of the wider 'The Old Warehouse' wharf development to the north. The western part of the site was occupied by several buildings, with an additional smaller building to the north and notably a 'pump' in the eastern corner. This layout was changed by 1893, with the site appearing distinctly separate from adjacent works areas and featured two buildings parallel with the north-eastern boundary. The WSP 2021 report suggested that the retaining structure along the north-eastern perimeter was likely constructed prior to 1893.

2.3.2 Minor alterations to the site layout reportedly occurred in 1948 and 1951 when buildings were removed and replaced by a garage in 1960, interpreted by WSP to include a canopy/forecourt to the west and a building to the east which was likely a shop. No notable changes to the site layout were reported until mapping dating to 2010 which suggested the site was vacant. Imagery from Google Earth Pro shows that the contemporary concrete slab was likely associated with construction activities on a nearby site.

2.4 Environmental Setting

2.4.1 The geology for the site is reported to comprise sands and gravels of the superficial Glaciofluvial Deposits, underlain by sandstone bedrock of the Chester Formation.

2.4.2 The Glaciofluvial Deposits are designated by the Environment Agency as a Secondary A Aquifer, whilst the Chester Formation is designated as a Principal Aquifer. Whilst the site is not located within a Source Protection Zone, there are eight groundwater abstractions recorded within 1km of the site, the nearest of which is reported approximately 575m to the north.

2.4.3 The nearest surface water feature was identified as the River Medlock located approximately 50m east of the site, which supplies the Castlefield Canal Basin 50m to the north. It is reported that the eastern half of the site lies within an Environment Agency Zone 2 flood zone.

2.4.4 There are no historical landfill sites recorded within 250m of the site, nor any records of historical mining or historical cavities within 1km. A number of potentially significant current and historic land uses have

been reported within 500m of the site, including numerous industrial or engineering sites, two petrol/fuel sites (both of which listed as obsolete), sixty-five historical garages or vehicle repair sites and ten historical tanks.

2.5 Encountered Ground Conditions

2.5.1 Intrusive works undertaken by TEC in August 2022 recorded the following generalised ground profile for the site.

Table 2.1: Generalised Ground Profile

Depth (mbgl)	Encountered Material
MADE GROUND	
0.0 – 0.23/0.5	Light grey reinforced concrete with 3-5mm rebar.
0.23 – 1.0/3.5	Reddish brown slightly clayey slightly gravelly sand with low cobble content. Gravels and cobbles of concrete, chert, sandstone and quartz.
0.5 – 4.0 (BH101)	*Brown slightly gravelly sand with gravel of brick, concrete and asphalt and weak petrol odour.*
0.23 – 1.0 (BH102)	*Dark brown to greyish brown slightly clayey gravel of tarmac, concrete and limestone.*
SOLID GEOLOGY – CHESTER FORMATION	
1.5/3.5 – 2.0/4.45 (BH102 & BH103)	*Firm reddish brown to dark brown slightly gravelly slightly sandy clay with gravel of fine to medium sub-angular to rounded chert.*
1.5/4.0 – 1.0/7.0	Medium dense reddish brown slightly clayey fine to medium sand.
1.0/7.0 – >25.0	Extremely weak to weal becoming moderately strong to strong reddish brown fine to medium sandstone.

2.5.2 While superficial Glaciofluvial Deposits have been depicted on geological mapping for the site, no superficial deposits were encountered during the intrusive works.

2.6 Groundwater

2.6.1 Groundwater strikes were unable to be discerned during drilling, due to water added to aid drilling. Standing depths of the groundwater within the boreholes recorded as part of subsequent monitoring visits at the site are summarised in Table 2.2 below.

Table 2.2: Summary of Groundwater Conditions

Location	Standing Depths (mbgl)			Strata
	17.08.2022	31.08.2022	29.09.2022	
BH101	2.7	7.12	7.07	Chester Formation
BH102	2.5	7.28	7.08	
BH103	3.31	-	-	
BH104	2.94	-	-	
BH03(1)	-	-	-	

Note: 1. Borehole installed by Structural Soils in 2016

2.6.2 An initial monitoring visit, conducted immediately post drilling, showed groundwater levels resting at approximately 2.5 to 3.3mbgl. However, during subsequent monitoring visits standing groundwater levels were noted to be at approximately 7.0mbgl.

2.6.3 It should be noted that groundwater conditions recorded during the investigation may not be representative of long-term conditions and that groundwater levels may vary in response to meteorological/ seasonal changes.

2.7 Contamination Summary

Visual or Olfactory Evidence of Contamination

2.7.1 Visual and olfactory evidence of potential hydrocarbon impacted material was recorded during the TEC intrusive works within shallow made ground, and also within the residual soil and upper surface of the underlying Chester Formation. Screening of these materials with a photo-ionisation detector recorded elevated VOC concentrations, with a maximum concentration of 305ppmv recorded within BH101 at a depth of 1.5mbgl.

2.7.2 In addition, the previous investigation undertaken by Structural Soils, recorded hydrocarbon odours and staining. Screening of the encountered materials with a PID reported a maximum of 2100ppmv within SS TP05 at a depth of 1.8mbgl.

2.7.3 While hydrocarbon odours and black staining were recorded within the made ground and the upper part of the Chester Formation in BH102, screening of the soil samples with a photo-ionisation detector (PID) recorded no concentrations of VOC above the instrument's minimum detection limit.

2.7.4 Screening of made ground materials from BH101 (noted to have a weak petrol odour, which was positioned in proximity to the locations of former petrol station tanks), with a PID recorded VOC concentrations of 5.5ppmv at 0.6mbgl, which increased to a maximum of 305ppmv at 1.5mbgl, before decreasing to 81.5ppmv at 3.5mbgl. Screening of the natural Chester Formation underlying these made ground materials recorded VOC concentrations that continued to decrease to 0.7ppmv at 6.3mbgl.

2.7.5 In addition, a rock sample recovered from a depth of 6.4m at BH102, was noted to have a "hydrocarbon smell" within the geotechnical laboratory sample description, although no significant olfactory evidence of this was recorded on site during the advancement of this borehole or on site sampling.

2.7.6 While laboratory analysis of representative soil samples did not record elevated TPH concentrations, an exceedance was reported for PAH compounds in a single location (TP102) when considering a residential without home grown produce site end use.

2.7.7 While olfactory evidence of potential hydrocarbon contamination was recorded within the natural ground materials encountered within BH03 between 3.7mbgl and 4.0mbgl, laboratory analysis of this material recorded TPH to be below the relevant GAC and therefore, no CoPC were identified within the natural ground.

2.7.8 In addition, laboratory soil analysis of made ground reported by Structural Soils indicated marginal exceedances of the relevant GACs for PAH compounds for a residential without home grown produce site end use.

Controlled Waters

2.7.9 Leachable CoPCs (heavy metals and total phenol) have been recorded within sampled made ground/natural Chester Formation from both investigations.

2.7.10 Further, laboratory analysis of groundwater samples collected by TEC from the site, recorded TPH concentrations above the screening values deemed protective of the identified controlled water receptors, together with elevated PAH, phenol and benzene concentrations. In addition to these determinands, Structural Soils recorded the presence of elevated concentrations of Aromatic TPH EC5-EC7 with the groundwater. While leachable heavy metals were recorded within the sampled made ground as part of the waste testing, no exceedances of these metals were recorded within the underlying groundwater.

Concrete

2.7.11 In accordance with BRE Special Digest 1, the results of water-soluble sulphate and pH testing undertaken on representative samples of the made ground and groundwater sampled yielded an Aggressive Chemical Environment Class (ACEC) of AC-1, requiring Design Sulphate Class DS-1.

Potential Sources of Ground Gas

2.7.12 Made ground was encountered across the site to a maximum depth of 4.0mbgl. In addition, hydrocarbon impacted materials, associated with the former PFS, were recorded on site.

2.7.13 Based upon the monitoring data obtained by both Structural Soils and TEC for the site, the site GSV is taken to be 0.0018l/hr, which is the worst case for methane and carbon dioxide. This GSV lies within the range of values designated for Characteristic Situation 1 and therefore, no specific ground gas protection measures are considered necessary within the proposed buildings.

Vapours

2.7.14 Given the elevated VOC concentrations associated with the identified hydrocarbon impacted materials, elevated TPH concentrations within the underlying groundwater, and the presence of significant below ground infrastructure associated with the former PFS on site, the potential risk from vapours cannot be discounted at this stage. Notwithstanding this, as noted above, it is proposed to reduce site levels by a depth of ~5.8m to accommodate the proposed basement and raft foundation for the proposed building. The reduction in levels will remove made ground from the site, together with up to 4.0m of residual soil and the upper rock surface of the underlying Chester Formation. This is considered to effectively remove the contamination source, mitigating the risks associated with potentially volatile contaminants of concern.

UXO

2.7.15 Stage 2 Detailed UXO Risk Assessment has been prepared by Brimstone Site Investigation Limited for the site (Report Ref: DRA-22-1433) which indicates that UXO poses a moderate risk to intrusive works.

2.8 Remedial Appraisal

Human Health and Controlled Waters

2.8.1 The proposed remediation works for the site is presented in TEC report referenced 2006023.004.01C and reference should be made to this report for full details. Notwithstanding this, a summary of the proposed works is presented in the following section.

2.8.2 The proposed remediation for the site comprises the removal of the PFS infrastructure and any associated grossly impacted material. As part of the proposed development, a reduced level dig of approximately 5.8m is to be undertaken across the majority of the site to facilitate the enabling works on site and the construction of the lower ground floor (basement).

2.8.3 While the removal of the PFS infrastructure and reduced level dig will likely remove any gross contamination present on site, it cannot be discounted that residual gross contamination may remain. Should this be the case, the in-situ ground materials will be inspected by a suitably qualified geoenvironmental consultant. Where significantly impacted materials remain, these should be chased back to their full extent with the excavated materials being disposed of appropriately.

2.8.4 It is considered that the removal of the PFS infrastructure and any associated impacted material will provide significant betterment in terms of groundwater quality, and a programme of groundwater monitoring is being implemented at the site to demonstrate this.

2.8.5 While CoPC have been recorded within the made ground during intrusive works undertaken to date, the current proposed development layout indicates the entire site is to be covered by hardstanding, including the building footprints, paved areas etc. Where present, such hardstanding would remove the identified potential contaminant pathways in relation to human health and proposed site end users, therefore, no further remediation is considered necessary with respect to these CoPC.

Potential Sources of Ground Gas

2.8.6 The ground gas risk assessment indicated the site to be designated as Characteristic Situation 1 and therefore, no specific ground gas protection measures were considered necessary within the proposed buildings.

UXO

2.8.7 A moderate UXO risk has been identified for the site and, therefore, it will be necessary to clear each pile location via a CPT magnetometer survey.

2.9 Remediation and Verification Works – October 2023

2.9.1 Remediation and Verification works are being undertaken under the supervision of BSL. As detailed within their interim Remediation Validation Report, referenced NS/C5511/12505 and dated October 2023, prior to the attendance of BSL on 7th September 2023, the concrete slab overlying the suspected PFS infrastructure was lifted by the earthworks contractor for the scheme. These works confirmed the presence of 6No. tanks, each reported to be approximately 2m x 3m in size with an estimated capacity of 9000-10000 litres. It was further reported that each tank was noted to have been decommissioned with sand / cement and that there was no requirement to pump or de-gas the contents prior to the commencement of removal. It was further noted that the tanks were enclosed with a brick bund on all four sides.

2.9.2 The initial remediation works comprised excavation and temporary storage of 2No USTs on impermeable hardstanding, together with the excavation of the soils immediately surrounding the tanks. The laboratory analysis of this material (BSL SP01) recorded TPH concentrations to be generally below laboratory limit of detection, with a maximum concentration of 23mg/kg reported for total TPH C5 – C40.

2.9.3 BSL later attended site for further point source remediation during the removal of the remaining USTs within this area of the site. The associated excavation was reported to extend to bedrock at a depth of 3.8mbgl, where the sandstone was noted to be visually impacted. The excavation was advanced further, with the assistance of a breaker, to a depth of 4.2mbgl, where the base of the excavation was noted to be 'clean' with no significant areas of hydrocarbon odours or staining remaining. A sample of the bedrock at the base of the excavation was collected and submitted for laboratory analysis (TKVAL1) together with a further base sample (TKVAL4) and 5No side wall samples collected from the eastern extent (TKVAL3), southern extent (TKVAL2 and TKVAL5), western extent (TKVAL7) and 1No from the northern extent (TKVAL6).

2.9.4 No visual or olfactory evidence of contamination was reported within the sidewall or base samples and screening of the collected validation samples with a PID recorded only marginally elevated VOC concentrations in TKVAL4, TKVAL5 and TKVAL6 (with concentrations of 8.2ppm, 0.2ppm and 6ppm recorded respectively) with concentrations of 0.0ppm recorded in the remaining samples.

2.9.5 Laboratory analysis of the representative samples recorded TPH to generally be below laboratory limit of detection. A marginally elevated total TPH (C5 – C40) concentration of 13mg/kg was recorded within TKVAL5. Based on the visual and olfactory records and the confirmatory testing undertaken by BSL, it is considered the remediation works undertaken within the south of the site to date, have resulted in complete contaminant source removal within this area. It should, however, be noted that further remediation works are required to the west and north of the existing excavation, once the contiguous pile wall has been installed, enabling safe excavation of materials.

2.10 Groundwater Monitoring – October 2023

2.10.1 Groundwater monitoring undertaken to date has identified Contaminants of Potential Concern within the underlying aquifer, and it is considered likely at this stage that the identified contamination is a result of vertical downward and limited lateral migration of contamination, associated with the identified onsite hotspots and infrastructure associated with the former PFS.

2.10.2 It has not been possible to maintain all the existing borehole installations due to limited space on site, ongoing site preparatory and enabling works and the removal of tanks and associated infrastructure. As a result, 3No new groundwater monitoring locations (BH201, BH202 and BH203) were installed on site by TEC in October 2023 (Figure 2), following completion of the initial phase of contaminant source removal, and subsequent validation works undertaken by BSL. The boreholes were positioned to capture monitoring data from what is considered to be both up-hydraulic gradient and down-hydraulic gradient of the identified contaminant source.

2.10.3 Sampling and analysis of the groundwater from within these locations was undertaken on two separate occasions. Laboratory test results generally indicate significant betterment in groundwater quality, following completion of the first phase of the remediation works undertaken to date. It is considered that completion of the remediation works proposed for the site (report ref. 2006023.004C) will result in further improvement in groundwater quality above that recorded to date.

3 FOUNDATION OPTIONS REVIEW

3.1 Introduction

3.1.1 The proposed development is understood to comprise the construction of 534No. Purpose Built Student Accommodation units within a 28-storey building.

3.1.2 On the basis of the ground conditions identified within the exploratory holes, conventional foundations are not considered appropriate, due to the potential loads associated with the proposed development and it is considered that a piled foundation solution would be the most appropriate founding method in this instance. In addition, the use of a ground bearing raft solution is also not considered feasible due to the potentially high column loads, the potential for excessive settlement and the need for tension piles to accommodate potential wind loading.

3.1.3 While full details have not been provided at this stage, as detailed on Shear Design Drawing titled "General Arrangement: Pile Layout", referenced DSM-SDL-ZZ-FX-DR-ST-0001-P02, it is understood that piles are to be advanced to be socketed into the sandstone bedrock of the underlying Chester Formation. At this preliminary stage, anticipated pile depths of between 8m and 13.5mbgl are anticipated for bored load bearing piles and 12.5m and 15mbgl for contiguous piles. Piles of between 780mm and 1080mm diameter are proposed for the main structural piles and 750mm for the contiguous piles.

3.1.4 Bored piles consist of drilling of an annulus which is infilled with wet concrete and a reinforcement cage, inserted to the required depths. The existing ground materials will be removed from the shaft of the pile and are likely to be disposed off-site.

3.1.5 The majority of the development will comprise either building footprint or hardstanding, with a new surface water drainage system installed, which will further reduce the risk to controlled waters. Given the presence of a basement across much of the site, significant earthworks, including the removal of 5.8m of material across the site will be undertaken and previously unidentified mobile contamination to this depth will be appropriately removed from site, further reducing the risk to groundwater.

3.2 Environment Agency Guidance

3.2.1 Environment Agency guidance on pollution prevention associated with piling and other ground improvement techniques is given in "Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination", Report NC/99/73.

3.2.2 In accordance with the guidance, the following generic founding types are considered:

1. Displacement piles;
2. Non-displacement piles; and
3. Penetrative and non-penetrative ground improvement methods.

Non-displacement Piles

3.2.3 Suggested non-displacement piles for use on this site include:

1. Continuous flight auger (CFA) piles; and
2. Bored and cased piles.

Displacement Piles

3.2.4 Suggested displacement piles for use on this site include:

1. Driven pre-cast displacement piles; and
2. Driven cast-in-situ displacement piles.

Penetrative and Non-Penetrative Ground Improvement

3.2.5 Penetrative ground improvement techniques, such as stone columns, are not considered appropriate for the proposed structure, due the type of the proposed structure (28 storey) together with anticipated design loads associated with the structure recorded. Therefore, this has not been considered further.

3.3 Proposed Pile Options

Non-displacement Piles - Continuous Flight Auger

3.3.1 Continuous Flight Auger (CFA) piles are a type of bored pile. However, due to the presence of rock at relatively shallow depths together with the size of some of the piles, it is considered that the use of CFA piles would be impractical for main load bearing piles; however, it is understood that they are to be considered for the proposed contiguous piled retaining wall.

3.3.2 CFA piles offer the advantage that they are less likely than smooth sided piles to enhance the downward migration of leachate. However, they generate some spoil, which may increase the potential exposure of site workers to contaminated materials and may increase lorry movements and volumes disposed of to landfill if it is not possible to re-use the material on-site. CFA piles may also result in localised ground disturbance and agitation of contaminated soils.

Non-displacement Piles - Conventional Rotary Bored / ODEX

3.3.3 Rotary bored piles are formed using a short flight auger to remove a column of soil and specialist tools to remove rock. If the hole requires support to remain open within made ground, for example, additional casing or, occasionally, support fluid, such as bentonite or polymer mud, can be used. A reinforcing cage is placed in the bore and concrete is then placed via a delivery tube or tremie

3.3.4 The term Odex is an abbreviation for Overburden Drilling EXcentric. Odex piling is a drilling method suitable for boring through boulders and rock strata, which would be considered suitable here, and involves a specialist heavy duty drill 'string' that is lowered into a steel outer casing. Once drilling starts, the Odex drill bit cuts ahead of the steel casing which enables a number of 'wings' on the bit to open out. The bit drills a hole with a diameter slightly greater than that of the steel casing. At the same time the 'shoulder' of the drill bit hits against a 'shoe' on the inside of the casing. This allows the steel casing to be hammered down simultaneously and closely behind the drill bit. High pressure air discharged through flushing holes in the face of the drill bit to push the drill arisings back up the casing to the surface.

3.3.5 Once the desired depth has been reached, the drill bit is turned once in reverse; the 'wings' fold back in allowing the drill to be withdrawn back up inside the casing. The casing tube can either remain permanently or be removed after the concrete or grouting process has been completed.

3.3.6 The pile is then filled with concrete or grout after a reinforcement cage or solid bar is placed.

3.3.7 While the advantages of using a bored pile system are such that any obstructions within the made ground can more easily be overcome and there is much lower noise and negligible vibrations generated compared with driven pile types, bored piles are likely to be more expensive and slower to construct than other forms of piling. Further, while considered to be of low volume, potentially contaminated soil (made ground) may be generated using this technique which would require appropriate off-site disposal.

Displacement Piles - Driven Piles

3.3.8 Driven pre-formed piling involves the driving of pre-cast concrete or steel piles into the ground, displacing the ground beneath the pile laterally during driving. The two types of displacement piles (driven pre-formed piles and driven cast-in-place piles) are considered unlikely to be suitable for the development due to the required depth of pile as the recorded strength of the underlying Chester Formation and therefore have not been considered further in this assessment.

4 FOUNDATIONS WORKS RISK ASSESSMENT

4.1 Introduction

4.1.1 The Environment Agency has produced a methodology/guidance that identifies six potential pollutant linkage scenarios for different pile types. This provides a basis to determine the most appropriate pile type for the particular site-specific setting to ensure that a significant pollutant linkage will not be created. The following sections provide a detailed risk assessment (as described in Report NC/99/73:"*Piling and penetrative ground improvement methods on land affected by contamination: Guidance on pollution prevention*") in order to identify a pile type, which is unlikely to create a significant pollutant linkage.

4.2 Hazard Identification

4.2.1 The following potential adverse environmental impacts have been reviewed and assessed. [The reference to pollution scenario – is consistent with the EA Report NC/99/73].

Pollution Scenario 1 - Creation of preferential pathways through a low permeability layer (an aquitard) to allow potential contamination of an aquifer.

Pollution Scenario 2 - Creation of preferential pathways, through a low permeability surface layer, to allow migration of landfill gas, soil gas or vapours to surface.

Pollution Scenario 3 - Direct contact of site workers and others with contaminated soil arisings that have been brought to the surface.

Pollution Scenario 4 - Direct contact of the piles or engineered structures with contaminated soil or leachate causing degradation of pile materials.

Pollution Scenario 5 - The driving of solid contaminants down into an aquifer during pile driving.

Pollution Scenario 6 - Contamination of groundwater, and subsequently, surface waters by wet concrete, cement paste or grout.

4.3 Risk Assessment

4.3.1 With relevance to pile installation and this assessment, the contaminants identified within the made ground, together with potential for hydrocarbon impacted soils are considered to be the main potential source of contamination, where elevated concentrations of heavy metals and total phenol have been identified.

4.3.2 Notwithstanding this, as part of the enabling and site preparation works 6No. UST's were excavated and removed from site together with any associated grossly impacted materials, as detailed within Section 2.9 of this report.

4.3.3 In addition, while the initial groundwater monitoring undertaken as part of the initial intrusive investigation recorded the presence of contaminants of potential concern included PAH and TPH compounds, subsequent groundwater monitoring, following the removal of the USTs and grossly impacted materials in proximity, recorded concentrations of the previously identified CoPC to be below laboratory limit of detection. While the initial remediation works have shown significant betterment in terms of groundwater quality, the potential for further residual contamination to remain within the areas not yet excavated cannot be discounted at this stage.

4.3.4 The Environment Agency guidance identifies the following indicative hazards associated with various piling and penetrative ground improvement methods. However, as indicated in the previous section, penetrative ground improvement techniques are not considered appropriate for the proposed structure and, therefore, have not been considered further.

4.3.5 References to risk estimations are made in accordance with the methodology presented in CIRIA publication C552 (2001) titled 'Contaminated Land Risk Assessment: A Guide to Good Practice'.

Non-displacement Piles - Conventional Rotary Bored, Odex and CFA

Scenario 1 - Creation of permeable pathways

4.3.6 The bore cased non-displacement pile will provide a method of drilling without the creation of a short-term pathway down the void created to construct the pile. The pile column will be constructed from the base of the hole upwards as the casing is withdrawn (or sacrificed). In some circumstances, this non-displacement method can reduce the density of the soils adjacent to the pile where coarse materials are encountered, which may create a long-term pathway through the made ground. However, based on the results of the intrusive investigations to-date, the probability is of this occurring is considered to be unlikely.

4.3.7 As the underlying geology is classified by the Environment Agency as Secondary A and Principal Aquifers and the close proximity of the River Medlock and Castlefield Canal Basin, the consequence of vertical migration of contaminated water is considered as severe.

4.3.8 The load-bearing piles will be within the footprint of the proposed building and will benefit from the presence of the basement floor slab together with the proposed drainage system, which will act to significantly reduce water infiltration and will reduce the possibility of contaminated water generated from the remaining made ground and potentially impacted soils/rocks reaching these piles. However, the propped contiguous piles along the boundaries would not benefit from the effects of the proposed slab and drainage system.

4.3.9 The made ground is already in continuity with underlying more granular strata, therefore no new pathways are considered to be created when using this method. In addition, following instalment of the contiguous pile wall, the made ground and upper part of the Chester Formation will be removed from within site, which will reduce the potential risk from contaminated materials in the long-term.

4.3.10 As a result, the risk associated with conventional rotary bored, Odex and CFA piles is considered to be low.

Scenario 2 - Migration of Ground Gas/Vapours

4.3.11 If the casing is to be removed, casting of the pile in-situ will create an intimate contact between pile shaft and soils and, therefore, likely to remove the pathway temporarily created by the construction of the void into which the pile concrete is cast. However, if the casing is to be sacrificial the pile will not form an intimate contact with any made ground or previously unidentified contamination, which may include hard objects, thus potentially creating a pathway.

4.3.12 Following the ground gas assessment undertaken as part of the Ground Investigation Report by TEC (ref: 2006023.001.01A), the general site area has been characterised as Characteristic Situation 1 in accordance with the Revised Wilson and Card Classification detailed within CIRIA C665 (for developments other than low rise housing).

4.3.13 In addition, while VOC's have been recorded on site, it is proposed to reduce site levels by a depth of ~5.8m to accommodate the proposed basement and raft foundation for the proposed building. The reduction in levels will remove made ground from the site, together with up to 4.0m of residual soil and the upper rock surface of the underlying Chester Formation. This is considered, as far as it is practical to do so, to effectively remove the contamination source, mitigating the risks associated with potentially volatile contaminants of concern.

4.3.14 While the consequence and bulk gas and vapour ingress is considered to be potentially severe, the probability is considered to be unlikely.

4.3.15 As a result, the risk is considered to be moderate/low.

Scenario 3 - Direct Contact of Site Workers and Others with Contaminated Soil Arisings

4.3.16 The pile hole construction technique will result in arisings of potentially contaminated soil being generated. These materials will potentially create a risk to construction workers and other site users who may come into contact with the spoil, including potentially hydrocarbon impacted soils and rock. As a consequence, good brownfield site working practices should be adopted by construction workers to mitigate against the potential risks, including the use of appropriate PPE. The arisings will be subject to Hazardous Waste Regulations and will require appropriate off-site disposal.

4.3.17 The probability is considered highly likely and its consequence is considered to be mild, although with good brownfield practices this may be considered to be minor.

4.3.18 As a result, the risk is considered to be low.

Scenario 4 - Degradation of Pile Materials

4.3.19 The pile will be in direct contact with any made ground or previously unidentified contamination and any associated perched water.

4.3.20 The piles will be constructed to prevent aggressive chemical environments from impacting the integrity of the pile and creating a pathway in the context of Scenarios 1 and 2. Where a sacrificial casing is not used, it is highly likely that the pile will come into contact with aggressive chemicals. However, if an appropriate design concrete design mix is used the consequence would be mild / minor.

4.3.21 As a result, the risk is considered to be low.

Scenario 5 - Driving Down Solid Contaminants

4.3.22 The boring technique removes soil from the base of the hole, resulting in arisings at the surface and may not drive contaminants into the ground. Further, quantities of made ground remaining within the casing at the end of the rotary element are considered to be negligible.

4.3.23 However, where casing is driven behind the ODEX head, minor quantities of made ground materials may be carried down as the drilling progresses. Further, research undertaken by the University of Sheffield on behalf of the Environment Agency and English Heritage ("Piling in layered ground: risks to groundwater and archaeology", ref: SC020074/SR, dated September 2006) indicates that even when considering driven piles vertical displacements typically were recorded to extend up to 1.5 pile diameters from the centreline of a cylindrical pile, but were mostly concentrated within a radius of one pile diameter.

4.3.24 Consequently, while it is recognised that there is the potential for some minor quantities of the made ground material / hydrocarbon impacted soils or previously unidentified contamination to be taken into the underlying materials, its effect is considered to be of minimal environmental impact and therefore the consequence is considered to be mild, while the probability has been determined as low likelihood, although the consequence of driving potentially contaminated material into the underlying aquifer is considered as medium to severe.

4.3.25 As a result, the risk is considered to be low.

Scenario 6 - Contamination of Groundwater by Concrete, Cement Paste or Grout

4.3.26 The concrete forming a bored or CFA pile is likely to be tremied to the toe of the bore with the pile being formed as the casing is withdrawn and concrete injection continues. The injection of concrete into the hole presents a risk of contamination of groundwater; however, the risk is low as the concrete should only be filling the void formed by the boring process.

4.3.27 Therefore, it is considered that the probability is unlikely, while the consequence to the aquifer is considered to be medium for this scenario.

4.3.28 As a result, the risk is considered to be low.

4.4 Summary

4.4.1 The guidance provides indicative hazards for each intrusive founding method. However, the following table indicates the potential for migration pathway creation due to piling, where, following the CIRIA publication C552, the Probability (P) ranges from negligible (0) Unlikely (1), Low likelihood (2), Likely (3) and Highly Likely (4), and the Consequence (C) ranges from Minor (1), Mild (2), Medium (3) and Severe (4).

4.4.2 The degree of risk is calculated by multiplying the likelihood by the effect, which are summarised in Table 4.1 and Table 4.2 overleaf.

Table 4.1: Risk Assessment Summary – Contiguous Pile Wall

Pile Type	Scenario 1			Scenario 2			Scenario 3			Scenario 4			Scenario 5			Scenario 6			Risk Score/ Overall Risk Descriptor
	P	C	R	P	C	R	P	C	R	P	C	R	P	C	R	P	C	R	
Continuous flight auger (CFA)	1	4	**4**	1	4	**4**	4	2	**8**	3	1	**3**	1	3	**3**	1	3	**3**	25 / Low to Moderate Risk
ODEX and drive	1	4	**4**	1	4	**4**	4	2	**8**	3	1	**3**	2	3	**6**	1	3	**3**	28 / Low to Moderate Risk
Bored and cased pile	1	4	**4**	1	4	**4**	4	2	**8**	3	1	**3**	1	3	**3**	1	3	**3**	25 / Low to Moderate Risk
Driven pre-cast displacement																			N/A
Driven cast-in-situ displacement																			N/A

Table 4.2: Risk Assessment Summary – Bearing Piles

Pile Type	Scenario 1			Scenario 2			Scenario 3			Scenario 4			Scenario 5			Scenario 6			Risk Score/ Overall Risk Descriptor
	P	C	R	P	C	R	P	C	R	P	C	R	P	C	R	P	C	R	
Continuous flight auger (CFA)																			N/A
ODEX and drive	1	4	**4**	1	4	**4**	4	2	**8**	3	1	**3**	2	3	**6**	1	3	**3**	28 / Low to Moderate Risk
Bored and cased pile	1	4	**4**	1	4	**4**	4	2	**8**	3	1	**3**	1	3	**3**	1	3	**3**	25 / Low to Moderate Risk
Driven pre-cast displacement																			N/A
Driven cast-in-situ displacement																			N/A

4.5 Conclusions of Risk Assessment

4.5.1 On the basis of the foundation works risk assessment and the existing site conceptualisation in relation to the proposed development, the potential risks associated with each potential pile type is generally considered to be of low to moderate risk and at this stage, the use of conventional rotary or ODEX/drive piles is considered most appropriate for the main load bearing piles of proposed development, while the use of CFA piles is considered most appropriate to form the proposed contiguous piled wall.

4.5.2 The site-specific conceptual model indicates there to be a low to moderate risk that the proposed CFA piles forming the contiguous piled wall would create a new pathway for contamination migration from the made ground into the underlying aquifer than is already present and any short-term pathways created by the piling are considered to represent a relatively low risk to the wider environment within the context of the current situation at the site and its environs.

4.5.3 While the proposed piles will result in the generation in arisings of possibly contaminated materials, it should be noted that mitigation measures for the appropriate disposal of generated contaminated horizons are to be implemented on site and therefore, the risk from direct contact of site workers and others with contaminated soil arisings that have been brought to the surface is low, where good brownfield practices are implemented.

4.5.4 Vertical displacement of materials during the advancement of conventional rotary piles is generally considered to be negligible / unlikely. Notwithstanding this, a marginally greater risk is considered for an ODEX and drive pile.

5 RISK MITIGATION

5.1 General

5.1.1 While it will be necessary for appropriate quality control and quality assurance measures to be enforced during all piling operations, to ensure the minimum risk to the environment results from the piling works. Due to the generally low risk at the site, the use of specific mitigation measures is not considered necessary in respect of controlled waters, site end users and construction workers above and beyond what will already be employed to enable site works and ensure the development is suitable for the intended use.

5.1.2 Notwithstanding this, it is recognised that there is the potential for some of the made ground material or previously unidentified contamination to be taken into the underlying materials, and while its effect is considered to be of minimal environmental impact, given the potential severe consequence, should contaminated materials migrate into the underlying aquifer, it is recommended that a pro-active approach is adopted through a programme of regular groundwater quality monitoring. This should be undertaken during and after the piling and basement excavation, to ensure the inclusion of the proposed piles and the formation of the basement has not resulted in the deterioration of groundwater quality from those of the established baseline conditions.

5.2 Recommendations

5.2.1 A programme of regular groundwater quality monitoring will be required. This should be undertaken during and after the piling and basement excavation, to ensure the installation of the proposed piles and the formation of the basement has not resulted in the deterioration of groundwater quality from that of the established baseline conditions.

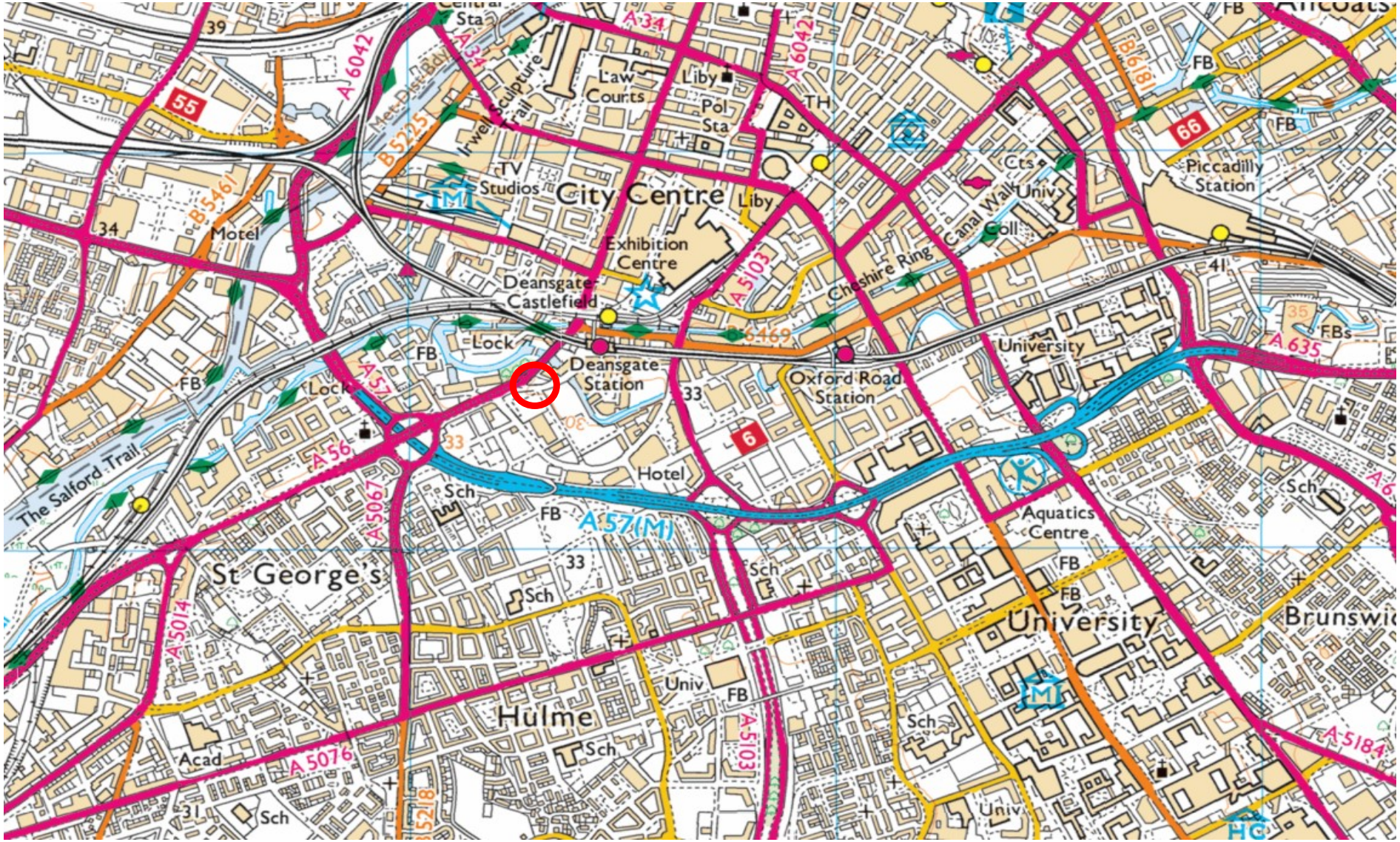
5.2.2 It should also be noted that the proposed works will generate waste soils, including those generated from the proposed piling works. It is the duty of the waste producer, to ensure that all waste is disposed of appropriately and that waste is sent to an appropriately licensed facility, with appropriate records kept in accordance with a suitable Materials Management Plan (MMP).

5.2.3 Stage 2 Detailed UXO Risk Assessment has been prepared by Brimstone Site Investigation Limited for the site (Report Ref: DRA-22-1433) which indicates that UXO poses a moderate risk to intrusive works and, therefore, it will be necessary to clear each pile location via a CPT magnetometer survey.

5.2.4 Should contamination be found at any time when carrying out the development that was not previously identified, an investigation and risk assessment may be needed, which may require this Foundation Works Risk Assessment to be reviewed and up-dated.

TEC

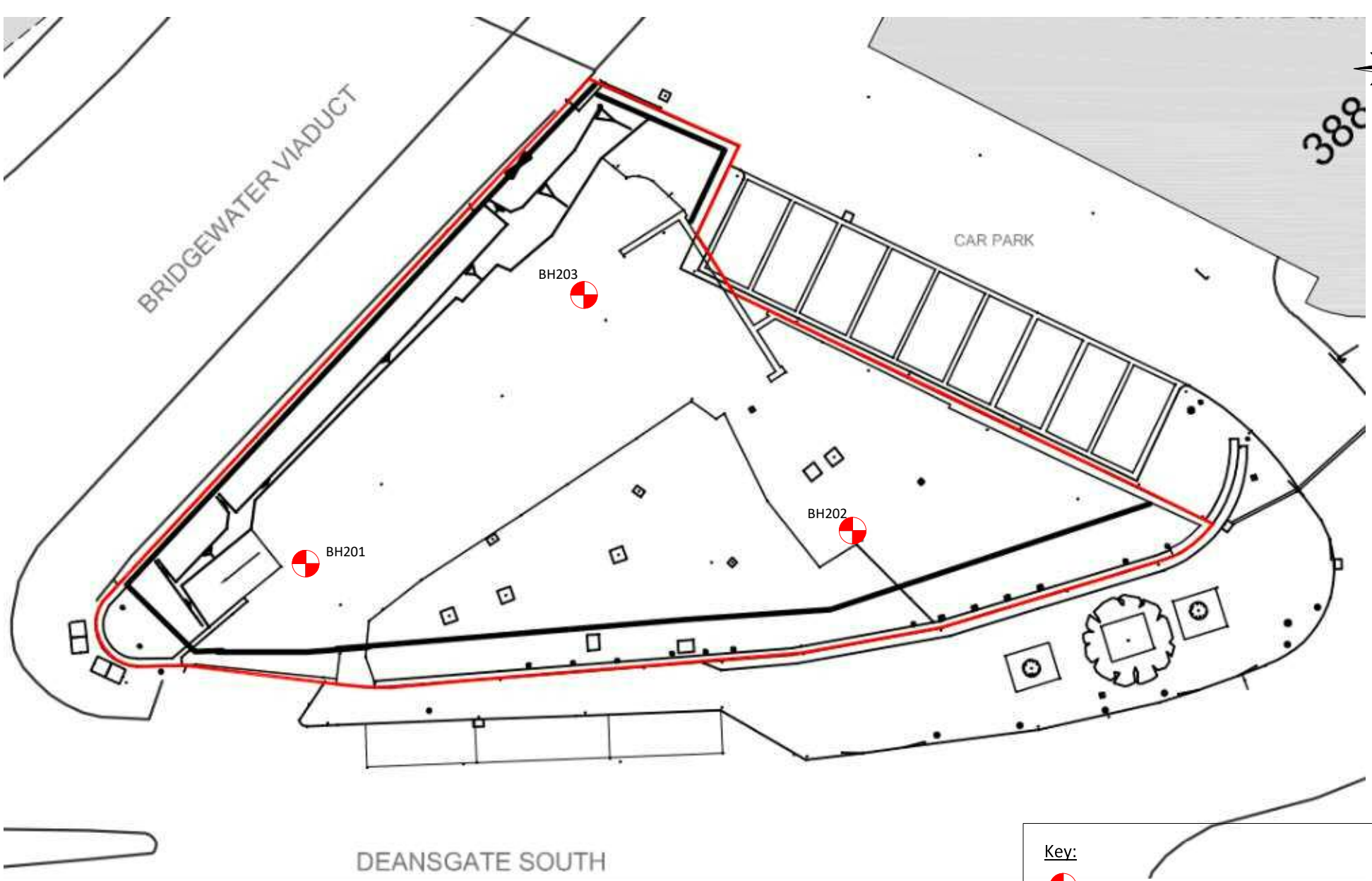
Figures and Drawings



Approximate Site Location:

Ordnance Survey © Crown Copyright [2022] All rights reserved.
Licence number 100043301

tec	TEC The Old Chapel 35a Southover Wells, Somerset BA5 1UH	Tel: 01749 677760 Email: info@tecon.co.uk Web: www.tecon.co.uk	Site Name: Deansgate, Manchester	Drawing Name: Site Location Plan	Client Name: Fusion Manchester Devco Ltd	Project No: 2006023.002	Figure No: 1	Date: July 2023	Scale: NTS



Extract of Drawing No. 0201 P-00

Key:

TEC Exploratory Hole

*All locations are approximate

tec	TEC The Old Chapel 35a Southover Wells, Somerset BA5 1UH	Tel: 01749 677760 Email: info@tecon.co.uk Web: www.tecon.co.uk	Site Name: Deansgate, Manchester	Drawing Name: Groundwater Monitoring Locations	Client Name: Fusion Manchester Devco Ltd	Project No: 2006023	Figure No: 2	Date: Nov 2023	Scale: NTS

The copyright of this drawing is vested with Corstorphine + Wright Ltd and must not be copied or reproduced without the consent of the company.

Figured dimensions only to be taken from this drawing. DO NOT SCALE.
All contractors must visit the site and be responsible for checking all setting out dimensions and notifying the architect of any discrepancies prior to any manufacture or construction work.

NOTES:

N

KEY

- SITE BOUNDARY

STUDENT ACCOMODATION

- ONE BED
- STUDIO
- EN-SUITE
- TWODIO
- SOCIAL SPACE
- PLANT/ CYCLES/ BINS

DEVLEOPMENT SITE
(UNDER CONSTRUCTION)

DEANSGATE QUAY

BRIDGEWATER VIADUCT

CAR PARK

LAYBY

DEANSGATE SOUTH

OWEN STREET

31.11
31.05
31.10
PPL 32.56
26.64
26.74
30.45
26.94
27.18
27.23
27.43
27.33
27.76
27.98
28.42
28.34
28.12
28.93
30.86
30.69
29.74
30.17
1:17 Ramp

Wet Riser Tank
Pump Zone
3500mm x 8000mm

Main Plant Room
+28.100

MDE Corridor

MDE Corridor
+28.100

Telecomms

Riser

Service Only Door

Maintenance Access Door Only

Lift A

Lift B

SV-01

Lobby

Comms Riser

Service Only Door

Stair 01

Stair 02
+28.100

UP

DN

Wet Riser

Riser

+28.100

Sub-Station
+27.985

Lobby

Two Tier
Cycle Racks

Semi-Vertical
Cycle Racks

LG.009
Cycle Store (141 Spaces)
78.0 m²

LG.001
Bin Store
47.7 m²

Bulky Waste
(6sqm)

Recycling

1100

X2 Wet Riser Tanks
(W1575mm x L3,750mm x H1650mm)

Detention Tank Zone

01 -LG - Lower Ground
1 : 100

Scale 1:100
0 5m 10m

Rev	Description	Date	Dr by	App by
T-07	Updated for new location for wet riser tanks and Plant Room layout updated	08/08/23	WT	CMc
T-06	Lower Ground Floor layout and Main Plant Room levels updated	21/04/23	WT	CMc
T-05	Drawings updated to suit comments from the Design and Client Team following the introduction of the new stair	06/04/23	WT	CMc
T-04	Tree positions updated in line with Transport Consultant's appraisal.	26/10/2021	BH	CMc
T-03	Updated in line with Transport Consultant comments.	18/08/2021	BH	CMc
T-02	Cycle store provision increased.	25/05/2021	BH	CMc
T-01	Updated for Planning Issue.	17/12/2020	BH	CMc
T-00	Planning Issue.	04/12/2020	BH	CMc

Project Stage

PLANNING

Client:
Fusion Students

Project:
Deansgate South,
Manchester

Drawing Title:
Proposed - Plan - Lower Ground Floor

Drawn	Checked	Paper Size	Scale	Date
BH	CMc	A1	1 : 100@A1	02/12/20

Drawing No.: 20269-0310
Revision: T-07

Drawing BIM Name:
12345-CW-XX-ZZ-M3-A-XXXX-S1.RVT

CDE Area:	Suitability Code:	BIM Revision:
		P01.04

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EXTENT OF CONTIGUOUS PILED WALL AND TEMPORARY WORKS TO BE CONFIRMED FOLLOWING EXPOSURE OF BELOW GROUND VIADUCT MASONRY INTO SITE BOUNDARY.

ALLOWANCE TO BE MADE FOR SHEET PILING BEHIND THE CONTIGUOUS PILE FOR FULL EXTENT OF HIGHWAY BOUNDARY SO THAT TO ALLOW FOR CONTIGUOUS PILES TO BE CUT DOWN AND CAPPING BEAM INSTALLED.

PROPOSED TEMP WORKS CONTIG PILE

MAIN CONTRACTOR MUST MAKE ALLOWANCES FOR ALL NECESSARY TEMPORARY WORKS/SHORING ETC TO SUPPORT EXISTING HIGHWAY DURING THE WORKS ALONG WITH ANY TEMPORARY WORKS SUCH AS CRANE BASES AND PILING PLATFORMS

CONTIGUOUS PILED RETAINING WALL REQUIRED TO ALLOW FOR CONSTRUCTION OF DEEP FOUNDATION BASE ADJACENT TO HIGHWAY. REFER TO SHEAR DESIGN FOUNDATION DRAWINGS AND SECTIONS.

EXTENT OF CONTIG PILED WALL ALONG GL 5 AND 6 TO BE CONFIRMED FOLLOWING CONCLUSION OF TEMPORARY WORKS DESIGN AND CONSTRUCTION METHODOLOGY

DESIGN OF PILING PLATFORM AND STABILITY OF PLATFORM/EXISTING STRUCTURES AT BOUNDARIES TO BE CONFIRMED BY TEMPORARY WORKS ENGINEER.

POSITION OF EXISTING MEDLOCK TUNNEL TO BE CONFIRMED AND PROXIMITY TO PILING WORKS TO BE SHOWN ON THIS DRAWING AT LATER STAGE. PILING CONTRACTOR REQUIRED TO PROVIDE RISK ASSESSMENTS AND METHOD STATEMENTS NOTING THE TUNNEL, POSSIBLE EFFECTS OF THE WORKS AND RISK MITIGATION MEASURES.

PILING CONTRACTOR TO ADVISE ON ALLOWABLE PROXIMITY OF PILING WORKS TO SITE BOUNDARY

ALLOWANCE TO BE MADE FOR SHEET PILING THIS CORNER TO ALLOW FOR FOUNDATION BASE CONSTRUCTION

SMALLER DIAMETER PILES PROPOSED TO BUILDING CORNERS DUE TO REDUCED TOTAL BUILDING LOADING. PILING CONTRACTOR TO CONFIRM THIS IS ACCEPTABLE WITH RESPECT TO DIFFERENTIAL SETTLEMENT BETWEEN PILE SIZES UNDER MONOLITHIC FOUNDATION BASE

PILE LAYOUT

1 : 50

1. PRIOR TO PILING/EXCAVATION ALL UNDERGROUND SERVICES MUST BE PROVEN TO BE NOT IN LOCATION OF WORKS
2. PILING PLATFORM TO BE PROVIDED AS CERTIFIED
3. PILING CONTRACTOR TO NOTE PROXIMITY OF LIVE HV CABLES AND TO ENSURE THAT DRIVING OF PILES AND ANY VIBRATIONS IS ABLE TO BE CARRIED OUT SAFELY AND DOES NOT ADVERSELY AFFECT LIVE CABLES

NOTES

GENERAL

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE. ALL LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS RELATE TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
3. DO NOT SCALE FROM THIS DRAWING. USE FIGURED DIMENSIONS ONLY.
4. ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY TO THE ENGINEER.
5. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, SUBCONTRACTORS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.
6. THIS DRAWING IS COPYRIGHT © PROPERTY OF SHEAR DESIGN LIMITED.

DIMENSIONS COLOUR KEY

DIMENSION — RED DIMENSIONS ARE UNVERIFIED

DIMENSION — BLACK DIMENSIONS HAVE BEEN VERIFIED BY ARCHITECT

THIS DRAWING MUST BE READ IN CONJUNCTION WITH SHEAR DESIGN DRAWING DSM-SDL-ST-0080 FOR ALL NOTES

REINFORCEMENT FROM PILE TO EXTEND INTO PILECAP/CAPPING BEAM MIN 40ϕ, EXACT CONFIGURATION IN ACCORDANCE WITH PILE DESIGNER SPECIFICATION

U/S PILE CAP

PILE CUT OFF LEVEL

50mm BLINDING CONCRETE

75

PILE CUT-OFF LEVEL

PILE DIAMETERS / LENGTHS AND LOADINGS*

PILE	DIAMETER (mm)	NUMBER	COMPRESSION SWL	NET TENSION (kN)	HORIZONTAL	DESIGN LENGTH (m)	CROPPED LENGTH (m)	TOTAL LENGTH (m)
	1050	48 APPROX	7500kN	1500	250kN	11	3	14
	750	15	4000kN	300	100kN	11	2.25	13.25
	750 CONTIG WALL	35 APPROX	2600kN/m	--	20kN/m² HIGHWAY SURCHARGE. 15MM DEFLECTION) REFER TO GEOTECHNICAL DATA FOR EARTHWATER PRESSURES	TBC	TBC	TBC
	600 CONTIG WALL	20 APPROX	2200kN/m	--	20kN/m² HIGHWAY SURCHARGE. (15MM DEFLECTION)	TBC	TBC	TBC
	400	14 APPROX	1500kN/m	--	TBC	TBC	TBC	TBC

* BASED ON PRELIMINARY ADVICE FROM GEOTECHNICAL ENGINEER AND SHALL NEED TO BE CONFIRMED BY DETAILED SPECIALIST PILING DESIGN.
BUILDING PILES TO BE DESIGNED AS FIXED HEAD.
SPECIALIST DESIGN TO TAKE INTO ACCOUNT EFFECTS OF NEGATIVE SKIN FRICTION AND DOWNDRAG.
PILING SPECIALIST TO PROVIDE DESIGN WITHOUT A LOAD TEST REQUIRED.
100% INTEGRITY TESTING TO BE PROVIDED.
NET TENSION INDICATES THE TENSION LOADING IN THE PILES AFTER THE CONSIDERATION OF FAVOURABLE VERTICAL LOADINGS AND IS THE SLS TENSION FORCE THAT THE PILES AND REINFORCEMENT NEED TO BE DESIGNED FOR.

TOWER CRANE BASE

DRAWING HAS BEEN PRODUCED IN ADVANCE OF ANY CRANE AND CRANE BASE INFORMATION. LOCATION OF CRANE BASE IS TO BE CONFIRMED, DESIGNED BY TEMPORARY WORKS ENGINEER, AND DRAWING SHALL BE UPDATED TO INCORPORATE TEMPORARY WORKS AS REQUIRED

TEMPORARY WORKS

CONTRACTOR(S) TO ALLOW FOR FULL DESIGN AND INSTALLATION FOR ALL TEMPORARY WORKS ITEMS INCLUDING ANY TEMPORARY RETAINING/SHORING OF SITE BOUNDARIES (HIGHWAYS) AND TOWER CRANE (INCL BASES).

PILING DESIGN AND MATERIALS

FULL DESIGN OF PILED FOUNDATIONS TO BE PROVIDED BY SPECIALIST. DESIGN TO INCLUDE MINIMUM PILE REINFORCEMENT REQUIREMENTS AND ANCHORAGE INTO MAIN BUILDING FOUNDATIONS.
DESIGNER TO MAKE THEMSELVES AWARE OF PROPOSED FOUNDATIONS PROPOSALS AND CUT OFF LEVELS AS A RESULT OF DEEP FOUNDATIONS CAPS.
PILING DESIGNER TO ALLOW FOR CONCRETE MIX TO SUIT BELOW GROUND CONDITIONS INCLUDING AC/DS CLASS.

PROTECTION OF GROUNDWATER

PILING CONTRACTOR TO REVIEW PLANNING REQUIREMENT FOR THE PROTECTION OF BELOW GROUND WATERS FROM CONTAMINATION DURING THE PILING WORKS.
CONTRACTOR TO ALLOW FOR PRE-CASED CONSTRUCTION AND BENTONITE PLUGS TO PREVENT CROSS CONTAMINATION FROM UPPER MADE GROUND LEVELS INTO GROUND WATER BELOW.
SUBJECT TO RECEIPT OF FULL SITE INVESTIGATION.

UNEXPLODED ORDNANCE

DETAILED UXO REPORT HAS CONFIRMED SITE IS A MODERATE UXO RISK SITE. ALLOWANCE TO BE MADE FOR SITE BRIEFING, SUPERVISION DURING EXCAVATION WORKS AND PRE-PROBING OF PILE LOCATIONS. REFER TO DETAILED REPORT.

SITE INVESTIGATION

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT GROUND INVESTIGATION REPORTS AND THEIR RECOMMENDATIONS AND REQUIREMENTS.

BELOW GROUND SERVICES

CONTRACTOR SHOULD REFER TO EXISTING BELOW GROUND SERVICES INFORMATION.

VIBRATION/MONITORING

ALLOWANCE TO BE MADE FOR VIBRATION/MONITORING DURING THE PILING WORKS SUBJECT TO FINAL REQUIREMENTS FOR PROXIMITY MEDLOCK TUNNEL

DRAWING FOR STAGE 4 DESIGN AND INITIAL COSTING PURPOSES ONLY. EXACT SETTING OUT AND DESIGN LENGTH OF PILES TO BE CONFIRMED AT NEXT DESIGN STAGE. DRAWING NOT FOR CONSTRUCTION.

PILE ARRANGEMENT, SIZES AND LENGTHS BASED ON INITIAL ADVICE FROM GEOTECHNICAL CONSULTANT AND PILING SPECIALISTS. EXACT ARRANGEMENT TO BE CONFIRMED WITH FINAL DESIGNER FOLLOWING RECEIPT OF FULL SITE INVESTIGATION

REV	DATE	DESCRIPTION	BY	CHK
P02	26.05.23	STAGE 4 ISSUE	AK	BGH
P01	31.10.22	STAGE 4 ISSUE	DF	BGH
A	02.09.22	UPDATED FOR STAGE 3+ ISSUE. NOTE ADDED FOR PROTECTION OF BELOW GROUND WATERS AND MONITIORING FOR PROXIMITY TO MEDLOCK TUNNEL	BGH	BGH

Revision Schedule

CLIENT: FUSION MANCHESTER DEVCO LIMITED

PROJECT: DEANSGATE SOUTH DEANSGATE MANCHESTER

TITLE: GENERAL ARRANGEMENT PILE LAYOUT

SHEAR design
Consulting Civil and Structural Engineers
7 Ashtree Court - Woodsy Close - Cardiff Gate Business Park - Cardiff - CF23 8RW
Tel : 029 2054 7000 - Fax : 029 2054 7001 - www.shear-design.com
Enquiries@shear-design.com

DRAWN:	CHECKED:	DATE:	SCALE:
AK	BH	21/07/22	As indicated@A0

STATUS: STAGE 4

SHEAR DESIGN REF:	DRAWING NUMBER:	REVISION:
20047	DSM-SDL-ZZ-FX-DR-ST-0001	P02
		STATUS: S1

05/06/2023 14:58:21

EXTENT OF CONTIGUOUS PILED WALL AND TEMPORARY WORKS TO BE CONFIRMED FOLLOWING EXPOSURE OF BELOW GROUND VIADUCT MASONRY INTO SITE BOUNDARY. ALLOWANCE TO BE MADE FOR TEMPORARY WORKS / SHEET PILING IN FOOTPATH TO ALLOW FOR CUTTING DOWN OF CONTIGUOUS PILES.

NOTE! DPM

DPM/DPC AND TANKING DETAILS BY OTHERS

RED LINE BOUNDARY

RED LINE BOUNDARY SHOWN HAS BEEN TAKEN FROM CWA DRAWINGS AND IS INDICATIVE, TBC BY FUSION

PILING BLANKET

PILING BLANKET LEVEL IS INDICATIVE AND IS TO BE DESIGNED AND POSITIONED BY CONTRACTOR TO SUIT PREFERRED SEQUENCE OF WORKS

SECTION CUTTING

SECTIONS HAVE CUT THE STRUCTURE AT AN OBLIQUE ANGLE IN SOME INSTANCES AND ELEMENTS ARE SHOWN WIDER THAN ACTUAL

PILE LOCATIONS

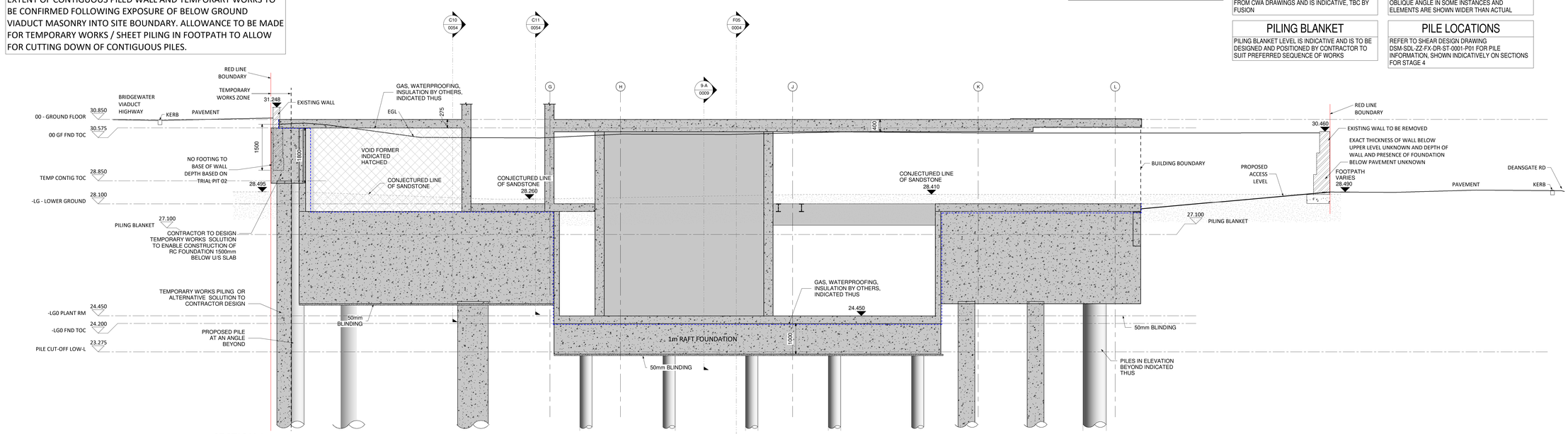
REFER TO SHEAR DESIGN DRAWING DSM-SDL-ZZ-FX-DR-ST-0001-P01 FOR PILE INFORMATION, SHOWN INDICATIVELY ON SECTIONS FOR STAGE 4

NOTES

GENERAL

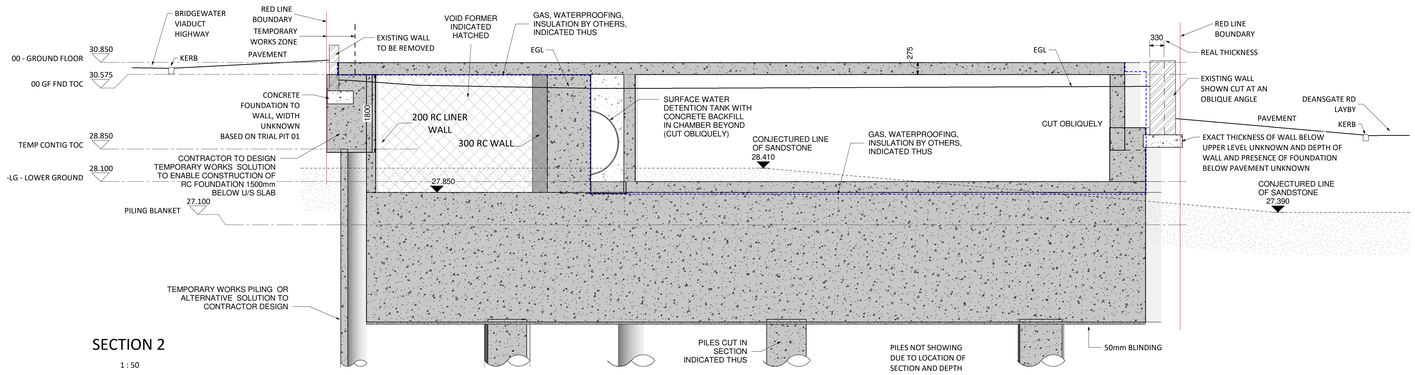
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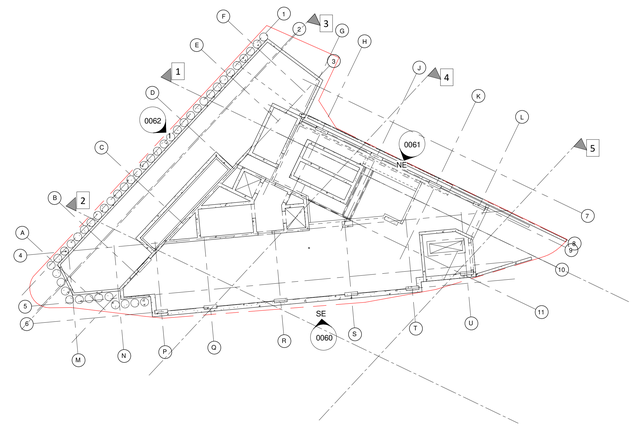
SECTION 1

1 : 50



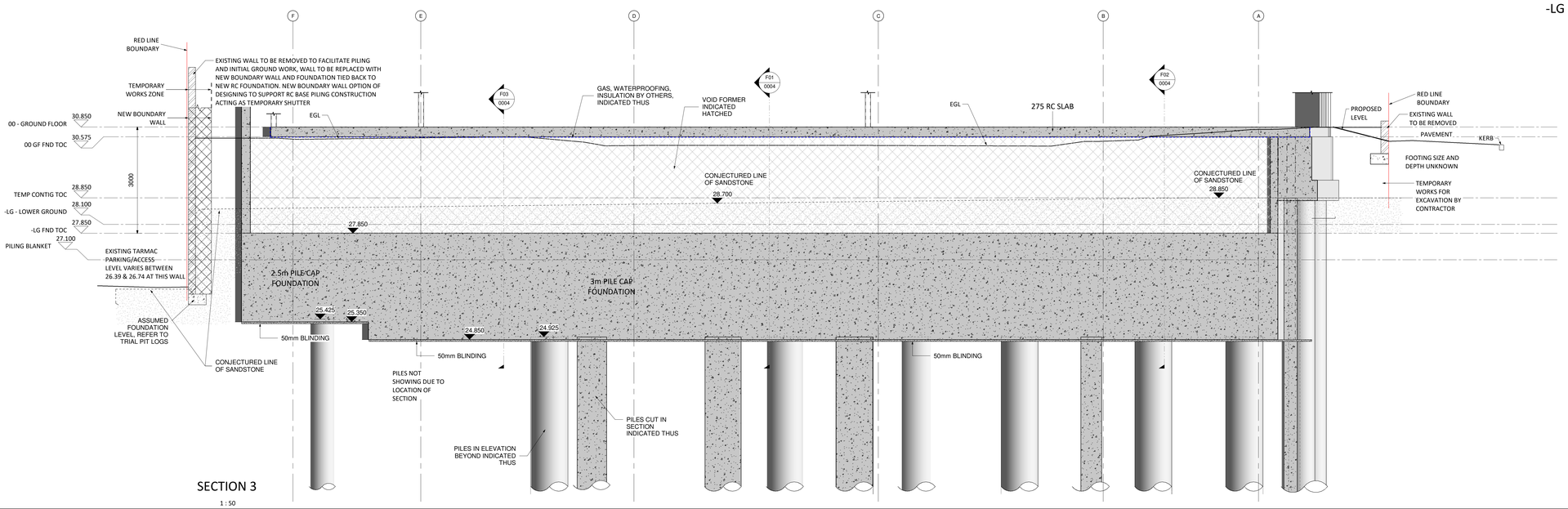
SECTION 2

1 : 50



-LG - LOWER GROUND - KEYPLAN

1 : 200



SECTION 3

1 : 50

REV	DATE	DESCRIPTION	BY	CHK
P03	26.05.23	STAGE 4 ISSUE	AK	BGH
P02	31.10.22	STAGE 4 ISSUE	DF	BGH
P01	26.08.22	STAGE 3+ ISSUE	AK	BGH

Revision Schedule

CLIENT: FUSION MANCHESTER DEVCO LIMITED

PROJECT: DEANSGATE SOUTH DEANSGATE MANCHESTER

TITLE: GENERAL ARRANGEMENT FOUNDATION SECTIONS 1

SHEAR design
Consulting Civil and Structural Engineers
7 Ashtree Court - Woodsy Close - Cardiff Gate Business Park - Cardiff - CF23 8RW
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DRAWN:	CHECKED:	DATE:	SCALE:
AK	BH	27/06/22	As indicated@A0

STATUS: STAGE 4

SHEAR DESIGN REF:	DRAWING NUMBER:	REVISION:
20047	DSM-SDL-ZZ-FX-DR-ST-0091	P03
		STATUS: S1

05/06/2023 15:06:30

NOTE! DPM

DPM/DPC AND TANKING DETAILS BY OTHERS

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SECTION CUTTING

SECTIONS HAVE CUT THE STRUCTURE AT AN OBLIQUE ANGLE IN SOME INSTANCES AND ELEMENTS ARE SHOWN WIDER THAN ACTUAL

PILE LOCATIONS

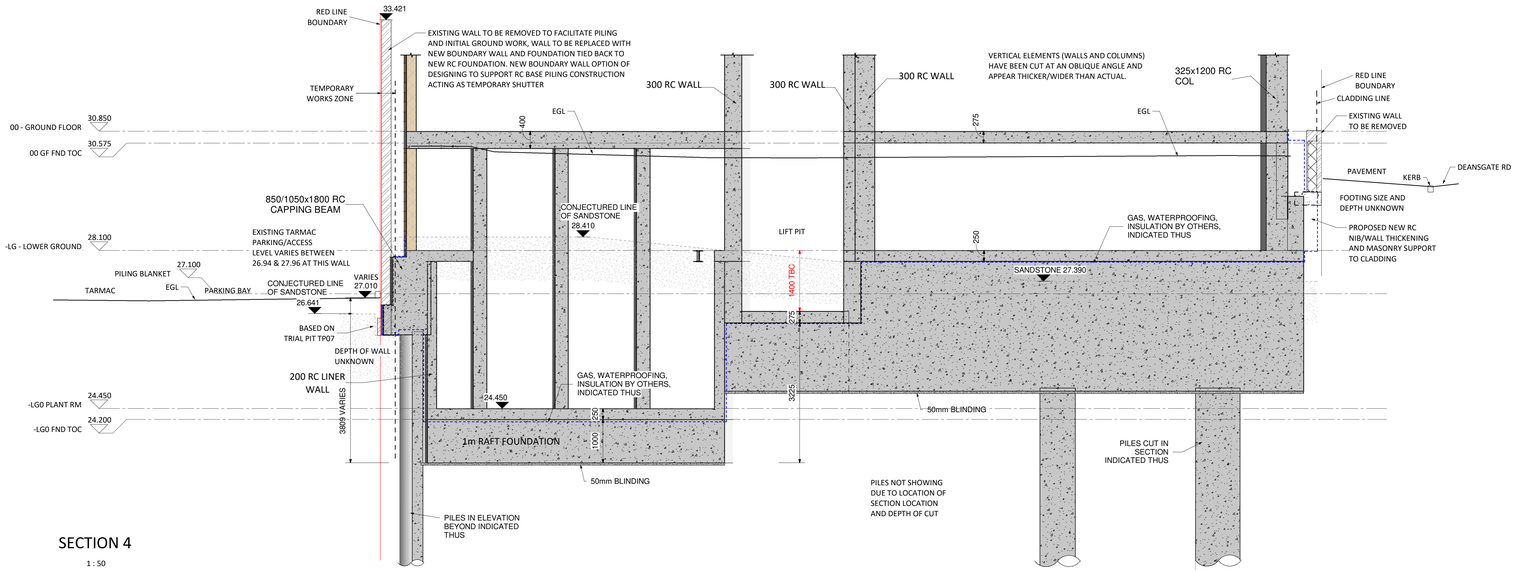
REFER TO SHEAR DESIGN DRAWING DSM-SDL-ZZ-FX-DR-ST-0001-P01 FOR PILE INFORMATION, SHOWN INDICATIVELY ON SECTIONS FOR STAGE 4

NOTES

GENERAL

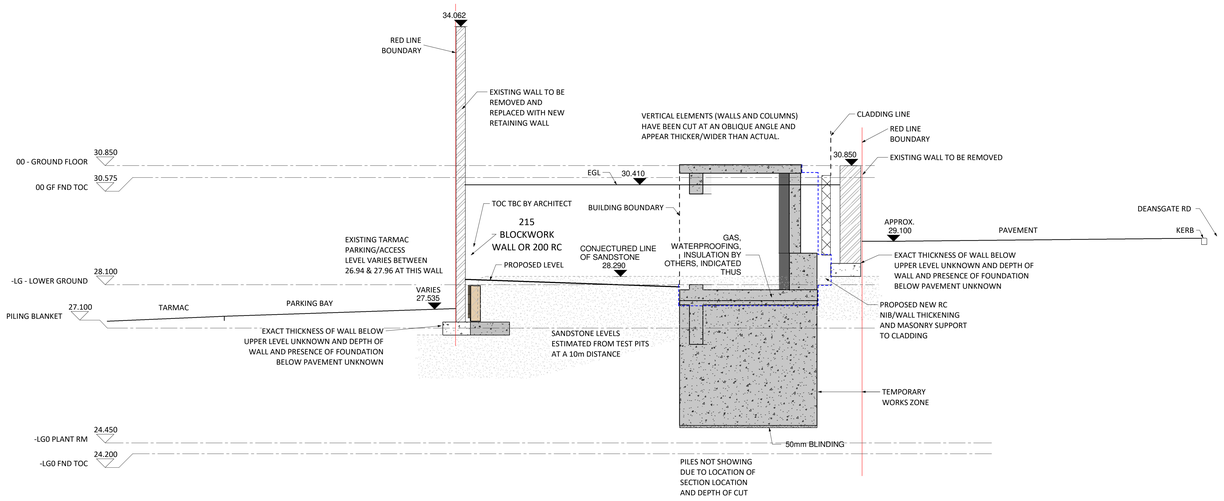
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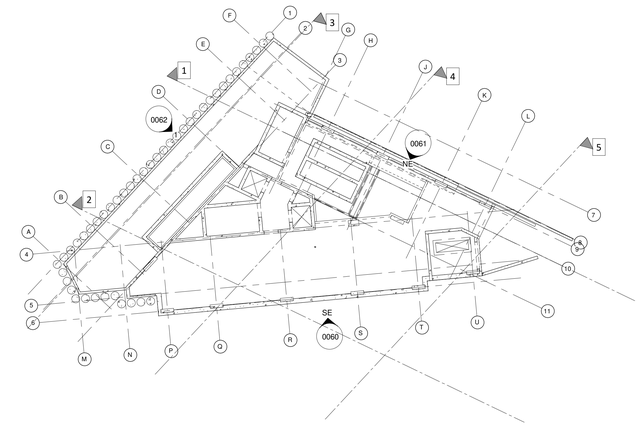
SECTION 4

1 : 50



SECTION 5

1 : 50



-LG - LOWER GROUND -- KEYPLAN

1 : 200

REV	DATE	DESCRIPTION	BY	CHK
P03	26.05.23	STAGE 4 ISSUE	AK	BGH
P02	31.10.22	STAGE 4 ISSUE	DF	BGH
P01	26.08.22	STAGE 3+ ISSUE	AK	BGH

Revision Schedule

CLIENT: FUSION MANCHESTER DEVCO LIMITED

PROJECT: DEANSGATE SOUTH DEANSGATE MANCHESTER

TITLE: GENERAL ARRANGEMENT FOUNDATION SECTIONS 2

SHEAR design
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DRAWN:	CHECKED:	DATE:	SCALE:
AK	BH	27/06/22	As indicated@A0

STATUS: STAGE 4

SHEAR DESIGN REF:	DRAWING NUMBER:	REVISION:
20047	DSM-SDL-ZZ-FX-DR-ST-0092	P03
		STATUS: S1

05/06/2023 14:56:46