



e3p

Pile Design Contaminated Land Risk Assessment
Bennett Street, Manchester

Reference:15-974-R5-1
Date: September 2023



PILE DESIGN CONTAMINATED LAND RISK ASSESSMENT

Bennett Street
Manchester
M12 5NL

Prepared for:
Kellen Homes



Report Ref: 15-974-R5-1
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QUALITY ASSURANCE

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This report has been prepared for the sole benefit, use, and information for the client. The liability of E3P T/O Environmental Engineering Partnership Limited with respect to the information contained in the report will not extend to any third party. This report has been prepared by the qualified persons as listed below.

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DRAWING LIST

15-974-001 - Site Location Plan
15-974-002 - Proposed Development Plan
15-974-005 - Exploratory Hole Location Plan
15-974-006 - Depth of Made Ground Plan
15-974-011 - Culvert Location Plan
15-974-014 - Depth to Bedrock Plan
15-974-023 - Historical Exploratory Hole Plan



1. INTRODUCTION

1.1. BACKGROUND

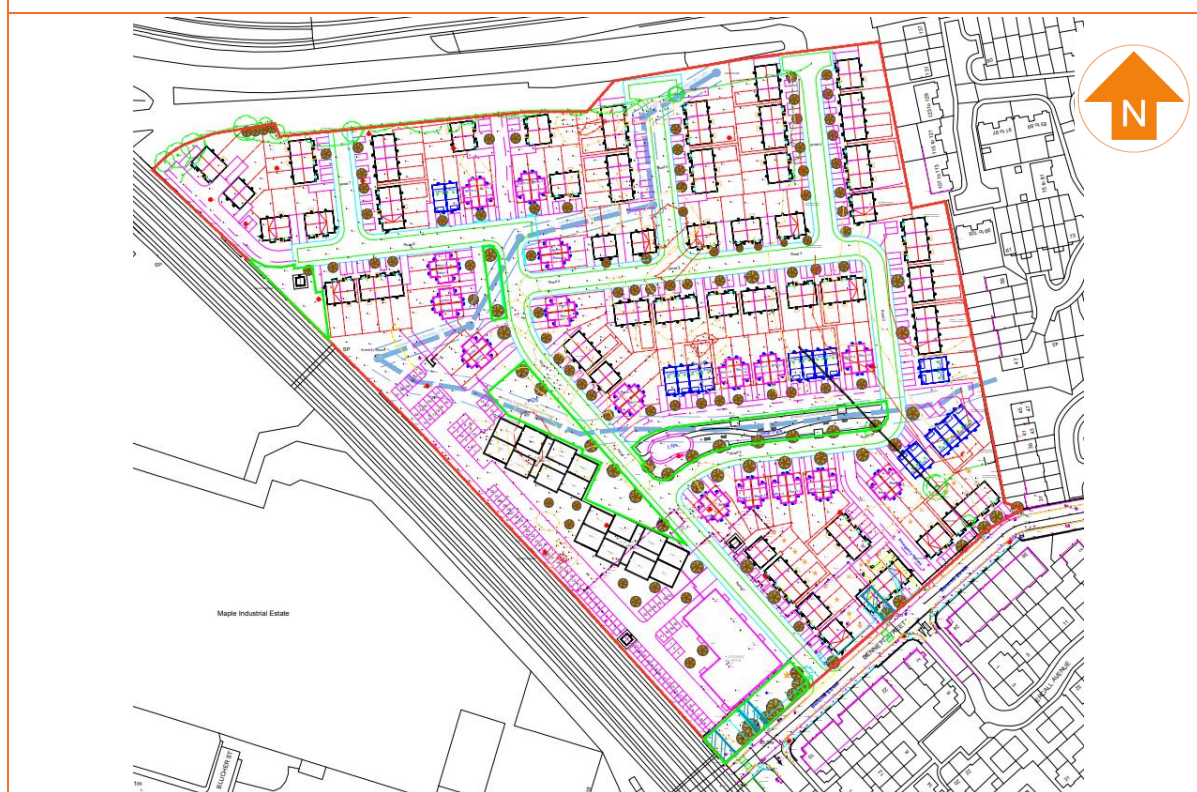
E3P has been instructed by Kellen Homes to undertake a contamination risk assessment for penetrative foundation systems, which is referred to as a Contamination Piling Risk Assessment, for a proposed mixed-use development at Bennett Street in Manchester; herein referred to as the site.

1.2. PROPOSED DEVELOPMENT

E3P understands that Kellen Homes intends to construct a mixed-use development comprising low-rise housing, apartment blocks, and café and retail units with adapted estate roads and infrastructure. Drawing 15-425-002 (Appendix III) identifies the proposed development layout.

A snapshot of the proposed development layout is indicated in Figure 1.1.

FIGURE 1.1 SNAPSHOT OF PROPOSED DEVELOPMENT



1.3. SCHEME BACKGROUND

Further information has been requested for the discharge of planning condition 13:

13. Piling or any other foundation designs using penetrative methods shall not be permitted other than with the express written consent of the local planning authority which may be given for those parts of the site where it has been demonstrated that there is no resultant unacceptable risk to groundwater.

The development shall be carried out in accordance with the approved details.



1.4. SCOPE OF WORKS

E3P has prepared this Contamination Piling Risk Assessment in due consideration of the Regulatory Authorities requirement to demonstrate that the proposed construction works will not present any unacceptable risk to controlled waters of the wider environ.

1.5. PREVIOUS WORKS

The following phases of Geo-Environmental investigations have previously been carried out at the site:

- ✿ **WYG** – *Phase II Geo-Environmental Ground Investigation Interpretative Report*. Reference E11056-1, January 2008. Prepared for Braidwater Ltd.
- ✿ **E3P** – *Phase I and II Geoenvironmental Site Assessment*. Ref: 15-974-R1-2, dated December 2022, prepared for Kellen Homes.
- ✿ **E3P** – *Ground Gas Addendum Report*. Ref: 15-974-R3-1, dated January 2023, prepared for Kellen Homes.

These reports have been used to form the basis of this Piling Risk Assessment.

1.6. CONFIDENTIALITY

E3P has prepared this report solely for the use of the client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from E3P; a charge may be levied against such approval.



2. GROUNDWATER CONTAMINATION RISK ASSESSMENT

2.1. GROUND CONDITIONS

MADE GROUND

Made Ground deposits have been encountered within all exploratory hole locations to a maximum proven depth of 5.45 m bgl (WS106). Although in general, Made Ground in the south of the site extends to circa 2.00 m bgl and 3.00 m in the north.

Beneath the main building in the south-east, Made Ground was proven to a depth of 1.30 m bgl and comprised concrete over yellowish-brown, slightly clayey gravel over reworked gravelly clay. Made Ground could not be proven to its full extent at WS106, WS111, WS112, WS115, WS124, WS128 and WS136. This was due to obstructions in the east of the site, cobbles within Made Ground or dense Made Ground. During the supplementary ground investigation, the full extent of made Ground could not be proven within five locations (TP107, TP110, TP123, TP126 and TP128) due to the instability of pits, pit collapse and the influx of groundwater.

In general, the majority of locations identified asphalt or concrete surface cover overlaying reworked gravelly clays containing gravel of mixed lithology, including brick, concrete, clinker, ash, ceramic, sandstone and coal. Beneath former structures in the north east and south of the site, concrete was generally underlain by blackish brown gravelly fine to medium sand, with gravels of concrete, mudstone, sandstone, and brick between depths of 0.40 – 2.10 m bgl (TP127). Fragments of metal, ceramic, and timber were also encountered within this material.

In one location, the concrete slab was underlain by soft grey clay with plant debris between 0.05 – 1.10 m bgl (TP118).

Hydrocarbon odours were identified in 16 of the 36 locations within Made Ground, with no evidence of any specific separate phase impact.

Relict foundations will likely be present across the site, beneath former and existing building footprints and railway tracks.

A Depth of Made Ground Plan is presented as Drawing 15-974-006 in Appendix III.

DRIFT

Drift deposits were identified within the majority of exploratory hole locations to a maximum proven depth of 30.50 m bgl (RB202). In general, drift deposits were encountered as a firm to very stiff brown CLAY with varying sand content. Drift geology was generally homogenous across the site.

Granular deposits comprising brown gravelly SAND with gravel of sandstone and mudstone were generally found at greater depth (>10.00 m bgl) overlying the bedrock.

Pockets of organic deposits were identified at 3.50 m bgl within WS113.

SOLID

Bedrock was encountered within the advanced rotary boreholes only between 12.10 m bgl (RB104) and 30.50 m bgl (RBH202) to a maximum proven depth of 40.00 m bgl. A red sandstone was identified beneath the drift overlying a reddish grey mudstone with sandstone bands.

In general, the bedrock is shallower in the east of the site and deeper in the west



GROUNDWATER

Groundwater was encountered between 0.50 m bgl to 1.80 m bgl during the site investigation. Subsequent monitoring recorded groundwater between 0.61 m and 3.40 m bgl.

2.2. TIER 2 CONTROLLED WATER RISK ASSESSMENT

Historically, the site has been subjected to limited infilling and several industrial uses including an iron foundry, transport depot, fuel storage tanks and a print works. Chemical by-products of manufacturing processes and coal tar sealant to cobble sets may have subsequently leached down into the underlying Ground impacting the localised discontinuous perched groundwater within Made Ground deposits.

The site is underlain by mixed geology, generally comprising cohesive clay present beneath a granular Made Ground, with cohesive deposits becoming interbedded with granular deposits with depth. Given the largely cohesive nature of drift deposits beneath the site, lack of potable water abstraction points and the site does not lie within an SPZ, the sensitivity of the aquifer receptors is significantly reduced.

During both phases of E3P investigation, a consistent water table was not identified, and since all locations advanced were underlain by low permeability CLAY, it is unlikely that vertical migration will occur at the site.

Groundwater was present within monitoring wells set within the underlying bedrock to 40.00 m bgl, indicating the bedrock aquifer is present within the upper 20.00 m of rock head.

The potential for lateral migration of mobile phase contamination through perched groundwater within granular Made Ground, towards the culverted surface water features cannot be discounted.

As the site is currently open with little hard standing surface cover, rainfall is not being intercepted and subsequently infiltrates freely into the underlying Made Ground, potentially mobilising the identified contaminants.

The proposed development will create hardstanding cover across the site, thus reducing the amount of infiltration generated. This will, in turn, reduce the number of contaminants present in leachate off the site and reduce the risk to the underlying culvert. Given that the site is underlain by low permeability clay, the leaching of contaminants into the culverts will be significantly reduced as the Made Ground beneath plots and roads will be contained beneath the impermeable surface covering, and beneath the natural clay aquitard and the Made Ground in gardens will be contained beneath the clean cover system, likely utilising low permeability CLAY as subsoil, and the natural clay aquitard beneath

Two branches of Corn Brook are recorded present on the site the site – Corn Brook, anticipated at the central area of the site running east west and Black Brook (Corn Brook diversion) anticipated to run from the north boundary in a south westerly direction. Both have been culverted.

Black Brook is to be abandoned and diverted into a newly constructed culvert, the lining of which will act as a barrier between any mobile phase contamination on site and the receptor. Corn Brook is to remain untouched. A full survey for Corn Brook is not currently available, therefore, at this stage it is assumed that it is in hydraulic continuity with the site, albeit localised.

As such, Corn Brook has been identified to be the critical receptor for controlled waters.

Relatively low level heavy metal and PAH contamination and limited TPH contamination has been identified in the soil and leachate analysis at the site. The source of the contaminants cannot be attributed to one area or point source and the majority of the contamination is considered present on a site-wide basis. Groundwater analysis has confirmed the presence of these contaminants Drawings within Appendix III show the extent of these exceedances on the EQS Exceedance Plan.



2.2.1. SURFACE WATER FEATURES

Within Black Brook heavy metal (copper and zinc), PAH (naphthalene, anthracene and fluoranthene) and TPH (C10-C16) exceedances have been identified in comparison the EQS. Exceedances of all the aforementioned contaminants have been identified in the leachate and perched groundwater across the site. However, as part of the proposed works Black Brook is to be diverted into a newly constructed culvert. The new culvert will comprise of a concrete cylinder, of which will act as a barrier between potential on site contamination sources and the surface water receptor, as such Black Brook will no longer be in hydraulic conductivity of the site. Upon completion of this work it is considered there will be no unacceptable risk to Black Brook.

Within Corn Brook – identified as the primary receptor – relatively low level heavy metal (zinc and total cyanide) and PAH (naphthalene) exceedances have been identified in comparison the EQS. Exceedances of zinc and naphthalene have been identified in the leachate and perched groundwater across the site, elevated total cyanide was present within leachate analysis. As elevated total cyanide is not present within perched groundwater in any location on site, it is unlikely that the total cyanide exceedances within Corn Brook originate off site, given that the migration pathway (perched groundwater) records no elevated total cyanide; this should be confirmed with supplementary testing up and down stream during enabling works. Additionally, an m-BAT assessment has shown that zinc is not considered bioavailable within Corn Brook, due to the RCR values being below 1. As such, zinc is not considered to pose an unacceptable risk to Corn Brook. The Tier 1 assessment has identified a possible pollutant linkage between naphthalene leaching from made ground soils across the site and migrating through perched groundwater to Corn Brook, culverted beneath the centre of the site.

A maximum recorded concentration of 36ug/l is recorded in Cornbrook Culvert. In reality, this is a marginal exceedance of the EQS within an urban environment with high background levels of PAH impact on soils and groundwater.

The culvert is noted to exhibit a significant flow with only confined fairly limited perched groundwater bodies, therefore, the potential for the site to create a significant contributing flow into the culvert is limited. In light of the above, it is highly probable that the recorded Naphthalene is representative of impact to the culvert from the wider urban area and not specifically from the development site.

A full survey for Corn Brook is not currently available, however, it is likely that the culvert is sealed off from the site as such, not in hydraulic conductivity. A survey should be completed to confirm the condition of the Corn Brook culvert, with repairs made in areas of degradation and damage. Upon completion of this work, it is considered that there will be no complete pollutant linkage.

2.2.2. PRINCIPAL AQUIFER

The site is underlain by a principal bedrock aquifer, with the top of bedrock encountered between 12.10 m bgl (RB104) and 30.50 m bgl (RB202). In addition, cohesive clay deposits have been encountered site-wide between 0.40 m bgl and 30.50 m bgl, the presence of which will limit the vertical migration of perched waters with potential dissolved phase impact therefore offering some protection to the underlying aquifer.

As part of the October 2022 E3P ground investigation, four deep water monitoring wells were installed within response zones set within the bedrock between 22.00 m and 40.00 m bgl.

Samples were obtained from each monitoring location, as per Table 9.4, relatively low-level exceedances of heavy metals and PAH were identified within BH202 and BH204 compared to EQS. Water storage in the bedrock aquifer is likely to form a baseflow to groundwater in the wider area. Given the lack of active groundwater abstraction recorded within 1km of the site, low permeability of the overlying drift limiting vertical migration and low solubilities and concentrations of heavy metal and PAH recorded, there is considered to be no unacceptable risk to the underlying aquifer.



During both phases of E3P investigation, a consistent water table was not identified, and since all locations advanced were underlain by low permeability CLAY, it is unlikely that vertical migration will occur at the site.

No exceedances of drinking water standards (DWS) were recorded within the principal aquifer at any location.

In light of the above, there is not deemed to be an unacceptable risk to the underlying aquifer from shallow residual impact within the Made Ground soils across the site. The developed CSM does not identify any significant pollution sources or viable exposure pathways.

2.2.3. CONTROLLED WATER SUMMARY

The results of the data review and Tier 2 qualitative risk assessment have allowed E3P to draw the following conclusions in respect to the risk to controlled waters:

- ✳ There have been multiple phases of ground investigation, which has enabled reasonable characterisation of the pollution risk and potential to impact the critical receptors;
- ✳ Low permeability cohesive clay deposits encountered site wide beneath the site will inhibit the downward migration of contamination and offer protection to the underlying aquifers.
- ✳ Site wide heavy metal, PAH and isolated TPH exceedances have been recorded within leachate analysis and perched groundwater. This is considered to be associated with residual impact to shallow anthropogenic materials. All primary and secondary pollution sources have now been removed from the site in their entirety. fluoranthene) exceedances have been identified in comparison to EQS. However, significant exceedances of naphthalene and TPH (C10-C16) exceedances have been identified in comparison to the EQS. This indicates a minor heavy metal and PAH impact is present within the surface water feature, with a more significant TPH and naphthalene impact likely associated the current and historic industrial activities in the area. Further surface water testing should be undertaken up and down stream of the site to confirm this.
- ✳ Within Corn Brook – identified as the primary receptor – minor exceedances of heavy metal (zinc and total cyanide) and PAH (naphthalene) exceedances have been identified in comparison the EQS. This indicates a minor heavy metal and PAH impact is present within the surface water feature, likely associated with the wider industrial activities in the area. Further surface water testing should be undertaken up and down stream of the site to confirm this.
- ✳ No exceedances of principal aquifer groundwater samples against DWS;
- ✳ Relatively low-level exceedances of heavy metals and PAH were identified within BH202 and BH204 compared to EQS. Given the of active groundwater abstraction recorded within 1km of the site, low permeability of the overlying drift limiting vertical migration and low solubilities and concentrations of heavy metal and PAH recorded, there is considered to be no unacceptable risk to the underlying aquifer.



- ✳ Within Black Brook, minor heavy metal (copper and zinc) and PAH (anthracene and
- ✳ Black Brook is to be diverted as part of the proposed development and will be fully encapsulated; as such, it is not considered that Black Brook will be in hydraulic continuity with the site upon completion of these works.
- ✳ Corn Brook is to remain untouched; at this stage, it is assumed that it is in hydraulic continuity with limited perched waters beneath the site. As such, Corn Brook has been identified to be the critical receptor for controlled waters.
- ✳ A full survey for Corn Brook is not currently available. However, it is likely that the culvert is sealed off from the site as such, not in hydraulic conductivity. A survey should be completed to confirm the condition of the Corn Brook culvert, with repairs made in areas of degradation and damage. Upon completion of this work it is considered that there will not be a direct contamination pathway between the site and surface water features, as such, no unacceptable risk to the controlled water receptor will be present.
- ✳ Further analysis of the surface water in Black Brook and Corn Brook should be undertaken as groundworks progress to ensure no future mobilisation of contaminants is caused, which may pose a risk to the watercourse.
- ✳ The agreed Remediation Strategy will ensure the removal of all perched (currently identified as discontinuous) groundwater at the near surface, this water will be transferred to a licensed facility for treatment.
- ✳ Where impacted soils are encountered within the full-depth excavation, processing and remediation of Made Ground, these will be assessed against Site Specific Remediation Targets (SSRT's) to ensure that any material with pollution that could pose a theoretical risk to the identified receptor is removed from site for treatment at a licensed facility. Materials outside the 15m zone of influence to Corn Brook will be assessed using a 50m compliance criteria with materials inside the zone of increased sensitivity to use a 15m compliance criteria.
- ✳ Upon successful completion of the remediation works, which will require a wholesale excavation of all anthropogenic materials, each and every pollution source will have been identified and removed to a suitably licensed treatment facility (as required). This will render the site low risk in terms of the potential for pollution to controlled waters in both the culvert and the aquifer.



3. PILE DESIGN CONTAMINATION RISK ASSESSMENT

3.1. PILE DESIGN

The scheme is to be constructed using a combination of Continuous Flight Auger (CFA) piles and Ground Improvement by the use of Vibro Stone Columns.

Vibro Stone Columns are considered to be ground improvement whereby treatment works are limited to the upper 3.0m to 4.0m below ground level and as such not specifically a penetrative foundation.

3.2. CONTAMINATION RISK ASSESSMENT

The piling risk assessment considers six pollution scenarios based on the site setting and ground investigation findings. These are discussed in Table 3.1.

TABLE 3.1 POTENTIAL POLLUTION SCENARIO

GENERIC POLLUTION SCENARIO	RISK	SITE CONSIDERATIONS
Creation of preferential pathways associated with potentially soluble phase compounds within the perched aquifer	Low	<p>The low permeability clay extending to depths in excess of 10.00 m bgl is considered an aquitard that will act to severely limit any vertical migration of soluble phase contaminants.</p> <p>VSC foundation works are limited to ~4.0m and, therefore no pathway creation.</p> <p>CFA piles are combined friction and end bearing within the high-strength superficial drift. Therefore they will not fully penetrate the low permeability clays during construction works. The CFA's are immediately sealed with a liquid concrete that will ensure no creation of long-term vertical migration pathway from residual perched waters.</p> <p>During both phases of the E3P investigation, a consistent water table was not identified.</p>
Creation of preferential pathways through a low permeability surface layer to allow upward migration of landfill gas, soil gas or contaminant vapours to the surface	Moderate	<p>The site has been assessed as Characteristic Situation 1, and gas protection measures would not be required if the site was considered within the context of the potential risk from CO₂ and CH₄.</p> <p>No sources of hazardous ground gasses are identified that could migrate as a result of the creation of preferential pathways by penetrative foundations.</p> <p>However, vapour mitigation measures are required to impede the ingress of volatile compounds from residual impact in the near-surface. Foundation works will do nothing to alter this risk and effect.</p>



GENERIC POLLUTION SCENARIO	RISK	SITE CONSIDERATIONS
Direct contact of site workers and others with contaminated soil arisings that have been brought to the surface.	Moderate	<p>The use of VSC displaces the soils laterally with no contaminated arisings at the surface.</p> <p>CFA piles generate spoil and arisings due to the augured method of installation. Consideration will be needed on potential contamination exposure of site workers from spoil and appropriate management of waste. Ground workers will be required to wear appropriate PPE to mitigate risks.</p> <p>All significant pollution in the soil and groundwater will have been remediated by source removal, and there is no abnormal or exceptional risk.</p>
Direct contact with the pile and potentially contaminated soil and leachable compounds	Low	<p>The concrete will be specified to a recognised standard according to the pH and sulphate concentrations recorded in the E3P site investigation. No other conditions have been identified that would pose a risk to buried concrete structures.</p>
The driving of solid contaminants down into the aquifer during piling	Low	<p>The land remediation works have significantly reduced the overall risk to controlled waters.</p> <p>The primary movement of soil during VSC piling is lateral, with a small potential for soils in contact with the sides and that base to be dragged down slightly before it is displaced. However, document EA NC/99/73 concludes that there are no recorded cases of this occurring.</p> <p>Furthermore, if any localised solid phase compound was inadvertently pushed downwards during piling, the soil would be quickly displaced laterally and as such the migration would be very minimal.</p> <p>The primary movement of soil during CFA piling is upwards and out of the hole. This limits the likelihood of driving contaminated soils downwards.</p>
Contamination of groundwater and, subsequently, surface waters by concrete, cement paste or grout	Low	<p>Cast in-situ CFA piles require injection of concrete into the Ground. Concrete mixes will be designed not to introduce any potential contamination to groundwater.</p> <p>Works will be completed in a highly controlled manner, therefore there is no potential for the lateral or vertical loss of a liquid concrete due to its viscosity and controlled mechanism for pumping and sealing.</p> <p>A surface water management plan should be implemented during the works to ensure potential run-off of concrete slurry is managed correctly to ensure no risk to surface watercourses or surrounding drainage networks.</p>



4. CONCLUSION & ASSESSMENT

The Piling Risk Assessment has determined that based on the underlying geology and groundwater conditions, Continuous Flight Auger (CFA) piles and Ground Improvement by using Vibro Stone Columns will pose a low risk.

All theoretical residual risks can be controlled to ensure that there is no pollution risk generated from penetrative foundation works.

The proposed methods offer a high degree of risk management and control to ensure there is no risk to a sensitive receptor.

This assessment is predicated on implementing the agreed remediation strategy that will ensure all significant pollution risk is removed prior to instigating foundation works in a specific sector of the site (this can be a phased approach).

VSC is terminated within the near-surface superficial drift deposits, and as such, their penetrative influence is limited.

The contamination in the shallow Made Ground and groundwater will be subject to remediation before the foundation works commence. No new migration pathway will be created between any residual perched water and the deeper aquifer, as the CFA piles will be sealed along the full depth of the installation, preventing any migration of mobile contaminants.

E3P consider that the underlying principal and secondary B aquifers will not be detrimentally impacted by the use of CFA piles or VSC at the site.

The foundation works will not create additional risk by a migration pathway to Corn Brook.

END OF REPORT



APPENDIX I

LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the Client as indicated in Section 1.3.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. During the site walkover, reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover, no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and do not constitute or replace full and proper surveys.
8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.
10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.



APPENDIX II

GLOSSARY

TERMS

ACM	Asbestos-containing material	MMP	Materials management plan
ADS	Acoustic design statement	ND	Not detected
AST	Above-ground storage tank	NDP	Nuclear density probe
BGS	British Geological Survey	NMP	Noise management plan
BSI	British Standards Institute	NPSE	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	NR	Not recorded
CA	Coal Authority	PAH	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	PCB	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	PI	Plasticity index
CIRIA	Construction Industry Research Association	PID	Photo ionisation detector
CLEA	Contaminated land exposure assessment	POS	Public open space
CML	Council of Mortgage Lenders	PPE	Personnel protective equipment
CoC	Contaminants of concern	ProPG	Professional practice guidance
CSM	Conceptual site model	QA	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	SGV	Soil guideline value
DWS	Drinking water standard	SPH	Separate-phase hydrocarbon
EA	Environment Agency	SPT	Standard penetration test
EQS	Environmental quality standard	SVOC	Semi-volatile organic compound
FFL	Finished floor level	TPH	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	UKWIR	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	UST	Underground storage tank
HCV	Health criteria value	VCC	Vibro-concrete column
ICSM	Initial conceptual site model	VOC	Volatile organic compound
LEL	Lower explosive limit	VRSC	Vibro-replacement stone columns
LMRL	Lower method reporting limit	VSC	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	WHO	World Health Organisation
MCV	Moisture condition value	WRAP	Waste and Resources Action Programme
MIBK	Methyl isobutyl ketone	WTE	Water table elevation



Bennett Street, Manchester

Pile Design Contaminated Land Risk Assessment

September 2023

m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	kN/m²	Kilonewtons per metre squared
ppb	Parts per billion	µm	Micrometre
mg/kg	Milligrams per kilogram (parts per million)		



APPENDIX III

DRAWINGS

Bennett Street, Manchester

Pile Design Contaminated Land Risk Assessment
September 2023

DRAWING 15-974-001 – SITE LOCATION PLAN

