BETTS GEO
CONSULTING ENGINEERS

25KMH022/PRA/JS/L1

17th March 2026

Chris Leighton
[redacted]

Dear Chris

PILING IMPACT ON GROUNDWATER – CRABTREE LANE, OPENSHAW – DRAFT DECISION NOTICE FOR 142609

1) Introduction

This letter report has been produced to assess the impact that the proposed piled foundations may have on the underlying bedrock aquifer under site. The following planning condition (Condition 16) has been placed on the site:

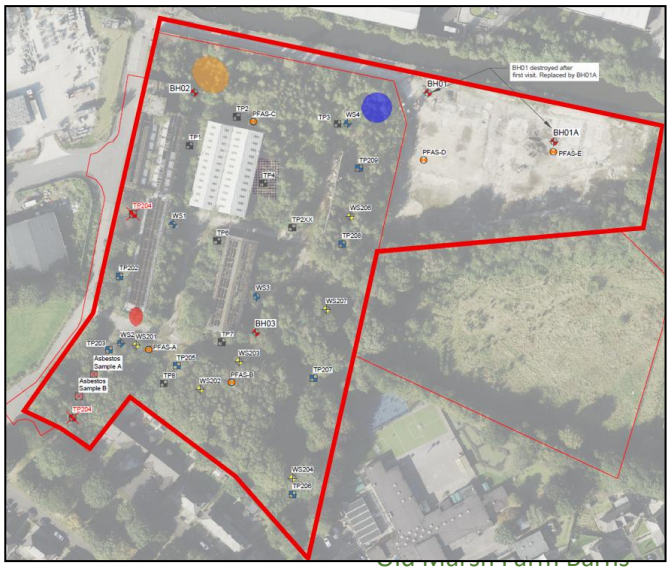
"Piling methods using penetrative methods shall not be carried out other than with the written consent of the local planning authority. The development shall be carried out in accordance with the approved details. Reason To ensure that the proposed ground improvement activity, does not harm groundwater resources in line with paragraph 187 of the National Planning Policy Framework and Position Statement J of the 'The Environment Agency's approach to groundwater protection' and in accordance with policy EN17of the Manchester Core Strategy (2012)."

The following reports should be read in conjunction with this letter:

- Phase I and II Geoenvironmental Site Assessment for Crabtree Lane, Manchester for Connell Developments by E3P – April 2024 – Report ref: 17-548-R1
- Ground Investigation Report for Pre Demolition, Crabtree Lane, Openshaw for MCI Development by Betts Geo – November 2022 - Report Ref: 21CHE276/GI

For ease, each area that the above reports cover are shown on the extract below. It is important to note that Betts Geo have undertaken two boreholes and 2 PFAS tests within the E3P area as of January 2026 (BH01 & BH01A and PFAS-D & PFAS-E). The Exploratory Hole Location Plan can be seen below;





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Reference is made to the following EA guidance documents:

- Piling in Layered Ground: Risks to Groundwater and Archaeology Science Report SC020074/SR 2006
- Environment Agency Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. NC/99/73 2001

2) **Site Setting:** including geology, hydrogeology, soil or groundwater contamination, topography, geotechnical considerations and requirements for piling or ground improvement methods.

Betts Geo Area

The site used to comprise three main structures in the west with the remaining areas being largely hardstanding which was generally heavily vegetated with self-seeded trees and bushes. The buildings were largely empty however, some machinery remained at the time of the walkover, as did a significant amount of waste. Asbestos was noted at the surface across the site but was focussed on the southern end of the western building. Also, within this building was a large 'oil' spill.'

It is documented that the site sits outside of a Source Protection Zone according to the Environment Agency. The bedrock deposits of the Manchester Marls are classed as a Secondary B Aquifer. There are no portable abstractions within 500m of site. The closest groundwater abstraction is located over 680m W of the site. The nearest surface water course is the Ashton Canal approx. 5m N of the site at a higher elevation.

Trial pitting and window sampling has been undertaken across the site with ground conditions proven to comprise of various types of MADE GROUND to depths of greater than 3.00mbgl. A 'pulpy' type material was observed in WS102 from 3.80mbgl – 4.00mbgl with the base not proven.

MADE GROUND was noted overlying the NATURAL STRATA of firm to stiff light brown sandy silty CLAY in WS101, TP1 from 1.20mbgl and TP209 from 1.90mbgl.

No groundwater was encountered during the fieldwork.

Elevated concentrations of various metals, asbestos, PAHs and SVOCs have been observed in the chemical samples of the made ground in a number of locations across the site, in addition to the surficial, visual and olfactory contamination observed during the site works.

Natural strata did not return any elevated results for contaminants tested for likely showing that the cohesive clay is confining any potential leaching/migration to the made ground, All determinants for Metals, TPHs and PAHs fell below the residential home grown produce guidance levels within natural strata. No significant mobile contamination has been observed. The risk of contamination to the adjacent canal to the north of the site is deemed low due to the anticipated cohesive superficial geology surrounding the clay preventing any significant contamination migration. A road/access track is also present between the canal and the site, increasing its distance from site.

E3P Area

The site area comprises a level plateau with mounds of material and stockpiled rubbish present with a small area of raised slab in the north. The site is predominantly covered in concrete and asphalt hardstanding, although there are areas of broken gravel surfacing. All former buildings have been demolished and no structures are on site.

A historic landfill is recorded to the south of site operating between 31/12/1942 – 31/12/1992 and receiving inert, industrial permitting regulations waste. The landfill appears to have encroached into the southern sector of the site.

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As per the Betts Geo area, it is documented that the site sits outside of a Source Protection Zone according to the Environment Agency. The bedrock deposits of the Manchester Marls are classed as a Secondary B Aquifer. There are no portable abstractions within 500m of site. The closest groundwater abstraction is located over 680m W of the site. The nearest surface water course is the Ashton Canal approx. 5m N of the site at a higher elevation..

Trial pitting, window sampling and cable percussive boreholes have been undertaken across the site with ground conditions proven to comprise variable MADE GROUND ranging between 0.60mbgl – 4.50mbgl, drift deposits of firm to stiff CLAY overlying a fine to medium SAND. In the deeper cable percussive boreholes a deeper horizon of gravelly CLAY was recorded at depths of between 7.1-8.2mbgl and 5.5-6.0mbgl respectively. The deeper SAND horizons were recorded to become very dense from ca. 7.0mbgl.

Groundwater strikes were recorded as slow ingress in the exploration holes at depths of between 1.3 mbgl and 6.0 mbgl. Monitoring to date has not recorded significant recharge in the monitoring wells.

Assessment against a residential end-use with plant uptake identified elevated arsenic, lead, zinc and asbestos as well as elevated PAH compounds. These were widespread throughout the Made Ground but not the natural strata.

Lead was recorded in two of the leachate samples in excess of the EQS value. E3P undertook an assessment using the Pb screening tool. The assessment confirmed that as the RCR value was below 1, E3P does not consider lead to pose an unacceptable level of risk to waters.

E3P stated that "*The groundwater beneath the site is likely at depth and based on the site setting is not considered a highly sensitive receptor being a secondary B aquifer and with no groundwater abstraction within the drift. A groundwater abstraction is identified ca. 650 m to the west but this is for evaporative cooling and is likely abstracting from the Chester Formation Sandstone and not the Manchester Marl which underlies the subject site.*

Ashton Canal is located at the northern boundary. However, this is not considered to be a sensitivity receptor as it is a lined artificial channel. The canal will be ca. 2.0 m deep and groundwater monitoring has confirmed that groundwater is greater than is at the south of the site; significantly below the base of the canal (3.68 m bgl – WS104). This would indicate a gradient away from the canal and provides evidence that the canal is not in continuity with groundwater."

Betts Geo Additional Boreholes Across Full Site Area

Betts Geo undertook three deeper cable percussive boreholes to a maximum depth of 20m in November 2025 for pile design. Two of these were in the Betts Geo area (BH02 & BH03) and one of these in the E3P area (BH01). The purpose of these holes were to assess the deeper ground conditions and install deeper monitoring wells for groundwater sampling purposes. Clean drilling and bentonite seals were used at the made ground and natural interface.

The ground condition of these holes comprised of MADE GROUND to a typical depth of 1.90mbgl, (however 7.50mbgl in BH03), Glacial till (CLAY) between depths of 1.00mbgl – 20.00mbgl, silty clayey fine to coarse SAND between 5.00mbgl – 18.00mbgl with possible weathered MUDSTONE being encountered between 15.00mbgl – 17.00mbgl in BH01 and 18.00mbgl – 20.00mbgl in BH02.

BH01 was destroyed after the first visit and therefore replaced by a further borehole for water monitoring – BH01A. BH01A encountered MADE GROUND to 2.00mbgl, firm CLAY between 2.00mbgl – 2.80mbgl and medium dense grey SAND & SAND & GRAVEL to 8.00mbgl.

BH01a was installed to 8.00mbgl, and BH02 and BH03 to 18.00mbgl. Groundwater was encountered between depths of 5.30m – 7.79m in BH01A, 6.25m – 14.85m in BH02 and 5.95m – 8.25m in BH03.

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Betts Geo PFAS Testing Across Full Site Area

E3P stated that "*No potential current or historical sources of PFAS have been identified onsite and no further risk assessment is required.*" The site has a history of packaging materials therefore Betts Geo deemed that PFAS testing was required before this assumption could be made. Betts Geo have undertaken PFAS testing of both soils and groundwaters across site.

Waters

Groundwater samples were taken from BH2 – BH3 on the 04/12/2025 and BH01 on the 15/01/2026 and PFAS samples taken from BH1 – BH3 on the 15/01/2026 and BH3 on the 16/02/26.

There is only one EQS for PFAS (4.4ng/l)- a statutory standard for perfluorooctane sulphonate (PFOS) listed under The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

In the absence of EQSs for other PFAS, thresholds are needed by the Environment Agency for assessing and managing the environmental risks from PFAS in rivers, lakes, estuaries and coastal waters. Deriving thresholds for PFAS is challenging for several reasons: (i) there are many PFAS, and they are chemically diverse and (ii) sufficient reliable and relevant (eco)toxicity data are only available for a few PFAS.

As of March 2025, there are no statutory standards for PFAS in groundwater in England and Wales; instead, the Drinking Water Inspectorate (DWI) has issued updated guidance with a precautionary guideline value of 0.1 µg/l or 100ng/l or 0.1 ppb) for the sum of 48 named PFAS in drinking water. Given the aquifer is the receptor (all be it reduced risk), DWI standards are deemed most appropriate in this situation.

The PFOS results in the groundwater testing are below:

15/01/2026

BH01 – PFOS total – 25.9ng/l
BH01 TOP ASSAY – PFOS total – 12.8ng/l
BH02 – PFOS total – 36.4ng/l
BH02 TOP ASSAY – PFOS total – ND
BH03 – PFOS total – 36.8ng/l
BH02 TOP ASSAY – PFOS total – ND

18/02/2026

BH03 – PFOS total – 36.8ng/l
BH02 TOP ASSAY – PFOS total – 44.63ng/l

The groundwater in the wells dried up on the last round of water sampling hence only once sample being taken from BH03. This suggests that this water is likely perched and correlate with E3Ps comment on low recharge.

The majority of PFOS results shown above exceed the very low EQS standard of 4.4ng/l however all 49 determinants tested for PFAS (49) and TOP Assay do not exceed the DWI standard of 100ng/l.

The heavy metals results in groundwater testing are below along with current guidance levels:

04/12/2025

BH02 – Zinc – 94ug/l. DWS Guidance value of 3,000ug/l or EQS value of 10.9ug/l. Only elevated against DWS.
BH03 – Cadmium – 2.1ug/l. DWS Guidance value of 5ug/l or EQS value of 0.25ug/l. Only elevated against EQS.
BH03 – Copper – 73ug/l. DWS Guidance value of 2,000ug/l or EQS value of 1ug/l. Only elevated against EQS.

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BH03 – Lead – 87.3ug/l. DWS Guidance value of 10ug/l or EQS value of 1.2ug/l. Elevated against both.
BH03 – Nickel – 372ug/lg. DWS Guidance value of 20ug/l or EQS value of 4ug/l. Elevated against both.

15/01/2026

BH01 – Lead – 1.5ug/l. DWS Guidance value of 10ug/l or EQS value of 1.2ug/l. Only elevated against EQS.
BH01 – Zinc – 38ug/l. DWS Guidance value of 3,000ug/l or EQS value of 10.9ug/l. Only elevated against EQS.

This choice between using the DWI guidance or the EQS depends entirely on the type of water being tested. DWI guidance is for drinking water and EQS for environmental waters such as groundwaters. Based on the site investigation undertaken on the site to date, the water encountered is likely to be perched and as such not 'true' groundwater. The underlying aquifer is also classed as a Secondary B Aquifer and therefore not deemed to be high risk. In regards to EQS standards and water abstractions, the closest groundwater abstraction is over 680m W of the site and therefore deemed as low risk receptor in this risk assessment.

Based on the above, neither guidance values are deemed fully appropriate, and the low levels of PFAS/heavy metal contamination encountered with the perched waters are deemed to be a low risk to groundwater receptors given their low sensitivity and the remedial proposals for the site. The Secondary B Aquifer without abstraction is not deemed a sensitive receptor but the only viable one in this scenario. The canal is not deemed to be a significant receptor due to its clay lining.

PFAS in Soils
Five (5 No) soil samples were taken across the site on the 06/01/2026 (PFAS – A to PFAS – E).

In regards to PFAS in soils, Betts Geo have used the guidance limits for Residential with consumption of homegrown produce as outlined below:

Table 4.1: Interim C4SLs for PFOA, PFOS, PFHxS and PFNA.

Land-use	Interim C4SLs ($mg.kg^{-1}$) (see notes below)			
	PFOA	PFOS	PFHxS	PFNA
Residential with consumption of homegrown produce	0.0076	0.013	0.0081	0.0073
Residential without consumption of homegrown produce	0.041	0.041	0.041	0.041
Allotments	0.0014	0.0027	0.0015	0.0013
Commercial	0.60	0.60	0.60	0.60
Public Open Space (residential)	0.079	0.079	0.079	0.079
Public Open Space (park)	0.17	0.17	0.17	0.17

None of the PFAS results in the soils showed elevated levels when compared against the C4SL values and therefore no further risk assessment is required.

3) **Site Remediation Already Undertaken**

Site has had a 3m turn over or down to natural by BSH.

A hydrocarbon hotspot was noted during this turnover in the vicinity of the proposed block A (see FZP in the appendix) and removed as part of the works. Their validation report is awaited and this report will be updated will full details once made available. This hotspot was perched into the clay at shallow depth and therefore no ongoing risk is anticipated now the source has been removed.

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4) Initial selection of piling method/Justification of the preferred method.

All of the plots across the site area are proposed for piled foundations (see Foundation Zoning Plan in the Appendix).

The larger apartment blocks to the north of the site are proposed for CFA piling a length of approximately 14m to 20m while the remainder of the site (low rise plots) are proposed for driven piling to a length of approximately 11m.

The driving factor to piling across the site area is geotechnical variability for foundations and cut / fill levels / benching is required to provide a development platform as well as the variable made ground depths across the site.

Based on the pile depths provided above (provided by designer), some of the piles for the large apartment blocks may extend into the underlying bedrock however, the majority are likely to terminate in the cohesive CLAY layer with a recorded thickness of >11m.

5) Identification of potential adverse environmental impacts.

As the site has had a full site turnover down to 3m or natural it is likely that the vast majority of contamination has now been removed where encountered or where necessary (hydrocarbon hotspot). As a result of the remedial work proposed across site, the contamination previously encountered during the ground investigation will be stabilised. The source-pathway-receptor model will be incomplete.

Caution should be applied in areas where made ground was identified to depths of greater than 3m as possible drawdown into the underlying aquifer if piled foundations are to terminate in the underlying bedrock (possible in vicinity of larger apartment blocks although CFA piles proposed in this area).

It is however noted that the underlying aquifer is deemed to be of low sensitivity and is classed as a Secondary B Aquifer.

6) Site-specific assessment of the identified risks to the environment, workers and end users.

No contamination exceedances were noted in the underlying natural strata during all phases of investigation, proving that the contamination is relatively immobile and insoluble, and the predominant clay is restricting any downward migration into the underlying bedrock (although bedrock is classed as low sensitivity – Secondary B Aquifer). Where sand / silt lenses do exist the thickness of clay above / below the layer exceeds the 2 x pile diameter criteria.

Following the 3m site turn over, recommendations for cover systems across the site are as follows:

- 600mm clean cover system comprising a basal break layer/membrane at the base

In regards to ground gas protection, the majority of the site has been classified as CS2 with hydrocarbon resistant membranes. This was going to be reviewed after remedial works.

7) Identification of any changes to preferred method and mitigation measures

A number of sand lenses were noted within the CLAY during the site investigation, however the piles across the majority of site are likely to seal groundwater movement given that clay has been identified to sit underneath the sand layers and on top of the mudstone bedrock.

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The piles proposed for the larger apartment blocks to the north of the site are proposed to a length of approximately 14m to 20m which may encroach into the underlying bedrock (clay has been found to depths of 20m on site).

The 'groundwater' encountered on site has also been determined as being perched and therefore not true groundwater as it dried up during the last round of water sampling. E3P also concluded that *"the groundwater beneath the site is likely at depth and based on the site setting is not considered a highly sensitive receptor being a secondary B aquifer and with no groundwater abstraction within the drift. A groundwater abstraction is identified ca. 650 m to the west but this is for evaporative cooling and is likely abstracting from the Chester Formation Sandstone and not the Manchester Marl which underlies the subject site."*

8) Identification of QA/QC methods and measures.

As per heading 7 above.

9) Justification of selected methodology: including mitigation, QA/QC and monitoring measures, with regard to geotechnical, financial and environmental considerations.

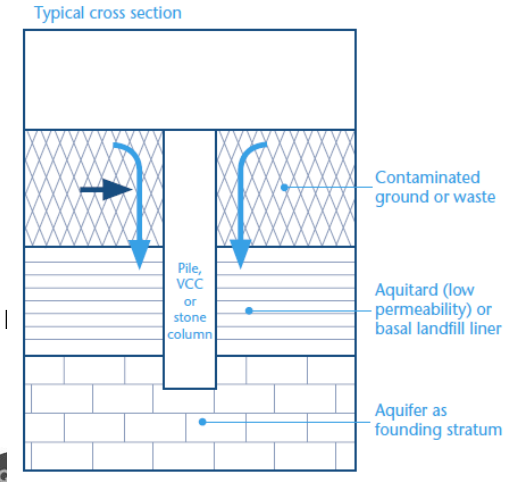
Piled foundations are the most cost effective solution for the proposed plots / variable geology and proves cost effective. The site has already undergone a 3m site turnover or down to natural which will have removed the significant contamination identified during all phases of the previous SI. Should any significant residual contamination still exist on site, the cohesive strata layers identified to up to 20mbgl will limit any groundwater movement between the superficial and bedrock layers. Furthermore, the underlying mudstone/marl bedrock is classed as a low sensitivity receptor (Secondary B Aquifer).

A small risk remains in areas where made ground has been identified as being >3m where deep piles are proposed (as part of the larger apartment blocks). However, as CFA piles are proposed for the larger apartment blocks, any contaminated made ground will be mobilised up to the surface as spoil and will not progress down into the underlying natural and as a such the risk is minimised.

Scenario of Best Fit Ground Model

When reviewing the 6 different scenarios put forward by the EA, no pollution scenario fits the site exactly. Pollution Scenario 1 and Pollution Scenario 5 can both be applied to the site.

Pollution Scenario 1 is the creation of preferential pathways through an aquitard to allow potential contamination of an aquifer.

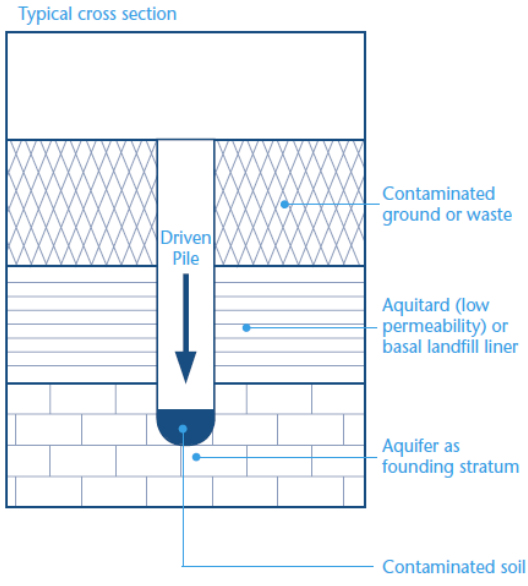


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- Polluting substances – leachable/mobile form? No following 3m site turnover or down to natural.
- Groundwater – directly beneath the site/in strata penetrated by piles/Major or Minor Aquifer/In hydraulic continuity with a surface water body – Superficial deposits classed as a Secondary Undifferentiated Aquifer and Bedrock deposits classed as both a Secondary B Aquifer.
- Aquitard/Aquifer – Will the piling or ground improvement method breach aquitard/the basal liner of a landfill site/penetrate an aquifer – Majority of piles anticipated to remain in cohesive clay layer given the depth of clay encountered during the deeper exploratory holes. Small risk in areas of deeper proposed piles in vicinity of apartment blocks to north of site however these are proposed to be CFA piles mitigates any risk of drawndown.
- Migration – Could contaminants in near surface deposits migrate into underlying aquifer or surface water body. No across majority of site - Piles anticipated to remain in cohesive clay layer given the depth of clay encountered during the cable percussive holes. Yes – in areas of deeper piles (apartment blocks) however these are proposed to be CFA piles which lower the risk.
- Pile Material – Is the pile made out of a material that could allow passage of contaminants? Pile design not confirmed yet but anticipated CFA piles in north of site close to the canal and driven pile across remainder of site.
- Preferential flow path – Will the piling or ground improvement method create a flow path for migration of contaminated perched water/leachate into an aquifer/surface water body? No across majority of site - Piles anticipated to remain in cohesive clay layer given the depth of clay encountered during the cable percussive holes. Potentially - in areas of deeper piles (apartment blocks) however these are proposed to be CFA piles which lower the risk.

Pollution Scenario 5 is the pushing of solid contaminants down into an aquifer during pile driving.



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Issues considered:

- Polluting substances – leachable/mobile form? No following 3m site turnover or down to natural.
- Groundwater – directly beneath the site/in strata penetrated by piles/Major or Minor Aquifer/In hydraulic continuity with a surface water body – Superficial deposits classed as a Secondary Undifferentiated Aquifer and Bedrock deposits classed as both a Secondary B Aquifer.
- Aquitard/Aquifer – Will the piling or ground improvement method breach aquitard/the basal liner of a landfill site/penetrate an aquifer – Majority of piles anticipated to remain in cohesive clay layer given the depth of clay encountered during the deeper exploratory holes. Small risk in areas of deeper proposed piles in vicinity of apartment blocks to north of site however these are proposed to be CFA piles which lower the risk.
- Drag down – Does the piling method involve the use of blunt-ended solid or closed- end piles that could drag down soil or open-ended tubular piles that could become "plugged" with soil? No – piling will involve the use of clean drilling techniques to prevent and unnecessary drag down and will be tipped end or pointed driven piles.

10) Ashton Canal

The Ashton Canal is located approx. 5m N of the site. This canal is clay lined and at a higher elevation that site and therefore is not deemed to be at risk from the piling activities proposed on site. However, a robust surface water management plan must be developed and implemented to prevent any surface runoff from the proposed CFA piles polluting the waterway adjacent to the site during the construction phase, and this must be implemented prior to the installation of any piled foundation.

11) Conclusion

There is a low risk of contamination migration identified both laterally and vertically due to site remedial works involving a 3m turnover or down to natural as well as the extensive cohesive superficial geology (despite sand bands) and the underlying aquifer being classed as a Secondary B Aquifer and therefore lower sensitivity.

The majority of piles are not anticipated to breach the cohesive CLAY geology which has been proved to depths of up to 20m.

A risk remains in the northern area of site where the anticipated pile depths are larger due to the size of the buildings however CFA piles are to be utilised in this area, and as a result of this pile method, any contaminated made ground will be mobilised up to the surface as spoil and will not progress down into the underlying natural strata, mitigating any remaining risk.

Betts Geo conclude, that as a result of the above, there is little to no risk of contamination migration into the underlying Secondary B Aquifer as a result of the foundation choice.

We trust that this information is satisfactory, however if you have any queries then please get in touch.

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Yours sincerely

Jenny Skues
Senior Geo-Environmental Engineer
BETTS GEO

Inc –
Foundation Zoning Plan

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Foundation Zoning Plan

not to scale

This drawing is not to be used for construction purposes, it is to be reviewed and updated following full proposed levels information and .dwg format drawings from which a detailed foundation level table can be produced - foundation solutions shown are therefore subject to change.

Numerous buried services within Crabtree Lane - obtain utility plans and carry out survey

Canal

Existing Sewer Easement - Exact route and extent TBA on a constraints plan

Anticipated Area of Existing Foundations

Existing Buildings and Anticipated Area of Existing Foundations

Former landfill area possible high walls not delineated in investigations

Deep culvert water course on southern boundary

High pressure gas main

In lieu of arboricultural information - Heave Protection to be allowed for as part of pile and Ground Beams designs.

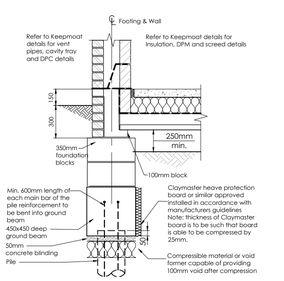
Foundation Key & Details

Small Diameter Driven Pile & Ground Beam Foundations

- Piling specialist to appraise themselves of site ground conditions and confirm piling as as suitable solution.
- Piling specialist to confirm that the Geo-environmental investigation etc is adequate fro the detailed design and specification of piles.
- Piling specialist responsible for design a selection of type of pile used
- Claymaster heave protection board or similar approved installed in accordance with manufacturers guidelines Note: thickness of Claymaster board is to be such that the board is able to be compressed by 25mm
- Voidformer required beneath all ground beams to provide 100mm void after collapse.

CFA Pile & Ground Beam Foundations

- Piling specialist to appraise themselves of site ground conditions and confirm piling as as suitable solution.
- Piling specialist to confirm that the Geo-environmental investigation etc is adequate fro the detailed design and specification of piles.
- Piling specialist responsible for design a selection of type of pile used
- Claymaster heave protection board or similar approved installed in accordance with manufacturers guidelines Note: thickness of Claymaster board is to be such that the board is able to be compressed by 25mm
- Voidformer required beneath all ground beams to provide 100mm void after collapse.



Typical External Wall Detail Pile & Ground Beam Foundation with Heave Protection

Pile designer to allow for heave in clay strata and negative skin friction where applicable

Ground Floor Slabs

GF1 The ground floor construction is to be suspended precast beam & block slabs or precast units (apartments) in accordance with Client details.

Plots affected by trees require an increased sub-floor void of 250mm is required.

Refer to plan, details & level table for plots requiring heave protection.

GF2 DPM, DPC & Insulation will be in accordance with Client details & specification.

GF3 Ground floors to incorporate CS2 Protection Measures - refer to Client standard details.

Concrete Mixes

CM 1 Concrete mixes shall be, UNO, Designated Mixes in accordance with BS 8500-2:2006, BS EN 206 - 1 & NHBC Standards as follows:

	Designated Mix	Consistence Class
General fill & blinding	GEN1	S3
Ground Beam Foundations	RC28-35	S3

The above mixes assume Design sulphate class and ACEC classification as noted in the Ground Conditions summary

Foundations

F1 Foundations are to be Piled Foundations where indicated.

F5 The foundation recommendations provided are based on the assumption the the site levels will be globally altered before foundations are excavated.
Should this not be the case Betts Associates should be made aware as soon as possible.

Drainage

D1 Drainage to take due account of clay plasticity in accordance with NHBC Standards Chapter 5.3.7

D2 Drainage to take due account of foundation depths and should be kept higher than formation levels.
Drainage that must be deeper than the proposed formation levels of adjacent foundations should be brought to the attention of Betts Associates

Heave Protection Table NHBC CH4.2 Table 7

Heave precautions shown are indicative and must be read in conjunction with the Foundation Assessment Plan and NHBC Standards 4.2 2021.

Void formers should accommodate movement in accordance with NHBC Chapter 4.2 Table 7

	Against side of foundation & ground beam	Under ground beam and suspended in-situ slab	Sub-floor void under precast B&B floor
Volume change Potential	Void Dimension [mm]	Void Dimension [mm]	Void Dimension [mm]
High	35	150	300
Medium	25	100	250
Low	0	50	200

1. For compressible material the void dimension is the amount the material should be able to compress to accommodate heave. The actual thickness of compressible material required should be established from the manufacturer's recommendations and is generally in the order of twice the void dimension shown. For void formers the void dimension is the remaining void after collapse. The actual thickness of void former required should be established from the manufacturer's recommendations.

Tree Influence Depth Contours

Tree contours are drawn using on the appropriate height in accordance with NHBC Ch4.2 at the time of removal or assessment. Should tree heights at the time of construction or removal be greater than those shown in the survey foundation depths will need recalculating.
Where clays are found to be desiccated at or near surface, a sub-floor void should be incorporated whether stated on this plan or not.

The following summarises the main issues highlighted by the Site Investigation report, but must not be considered exhaustive.

Summary of ground conditions at shallow depth	Ground conditions generally consisted of made ground at varying depths up to 4.50m below existing ground level. Clay and sand where encountered from 0.20m to 10.00m below existing ground level. Many areas where not surveyed due to dense vegetation.
Tree Influence?	Assumed necessary - Parts of site are densely vegetated - Arboriculture survey is required.
Clay Plasticity	Low or Moderate
Groundwater and Shallow excavation instability?	Perched ground water is likely - water strikes vary between 1.3 and 6.0m BGL Refer to geo-environmental reports for detailed assessment of groundwater and impacts on controlled waters/sensitive receptors
Contamination	Refer to Geo-environmental reports for recommendations for dealing with contamination aspects and remediation strategics.
Obstructions	Former and existing foundations expected throughout site.
Mining	The site is located within a Coal Mine Reporting Area but there are no crops, shallow seams or shafts within 1 km of the site. Furthermore, the site is not within a Development High-Risk Area with any coal deposits likely at significant depth beneath the Manchester Marl Formation
Ground Gas Protection Measures	CS2 level of gas protection due to prevalence of made ground - final assessment is subject to further monitoring and detailed land gas assessment
Radon Protection Measures	None Required
Design Sulphate Class	DS1 generally - DS 3 adjacent to TP103 (e3p log) on East parcel and DS1s adjacent to WS101 (Betts geo log) on west parcel.
ACEC Class	AC1s generally - AC2 adjacent to TP103 (e3p log) on East parcel and AC2 adjacent to WS101 (Betts geo log) on west parcel.
Flood Risk	Refer to Flood Risk Document
Environmental Constraints	Refer to GI
Bearing Capacity	Varies - At this stage a fully piled solution is being considered.
Further Investigation needed	Tree Survey - Arboricultural Report Full Survey of areas within dense vegetarian. Post demolition Site Investigation is required Additional gas monitoring and ground gas assessment Possible active Culvert investigation Site Remediation Strategy TBA

General

G1 This drawing is to be read in conjunction with the following information:

Site Investigation: E3P Phase I and II Geo-environmental Site Assessment 17-548-R1 - April 24
SI Review of Norwest Holst by RSK - 2006
Crabtree Lane Openshaw - Jackson Land Phase I & II SI (June 22 Betts Ref 21CHE276-DSGI Rev 1)

Topographical survey: MCLTS_115_E Crabtree Lane, Openshaw - Topo Survey

Planning Layout: 02292_ITP_MP_00_DR_A_1100 - Level 00 - Proposed Site Plan_P02

FFL's: Received KHM28 - 0101 - P05 - Preliminary Drainage Layout - A1

Arboricultural Report: Not Received

G2 The foundation types indicated are based upon observations & field tests during the site Investigation.
Third party information, accepted in good faith, may also have been used in this assessment.

It should be recognised that strata may vary considerably between sampling points and that groundwater regime may be influenced by seasonal or other factors.
The foundation types, and depths where applicable, are therefore 'for guidance purposes only', and should be continually reviewed in light of actual site conditions encountered during construction work and/or ongoing investigations.

G3 With reference to landscape proposals, it has been assumed that any new planting will be of a species, and so sited, as to not affect the proposed substructure construction.

G4 Foundation depths and precautions to foundations and floor slabs have been assessed in accordance with NHBC Standards Chapter 4.2 'Building Near Trees'. These have been assessed using known existing and proposed ground levels. If proposed ground levels are amended after issue of this drawing refer to Betts Associates for further advice.

G5 All construction work in close proximity to trees is to be in accordance with BS 5837: 2005 'Trees in relation to Construction'

G6 Where necessary foundations may be stepped in accordance with NHBC standards and Part A of the Building Regulations.

G7 Drainage constructed in/ over clay strata must be designed to take account of movement due to clay heave in accordance with NHBC Standards 2021 Ch4.2.11.

G8 All foundation design is based on shallow plot drainage - circa 1m deep BPGL. Any drainage by others that poses a risk of undermining the foundation should immediately be brought to the attention of Betts Associates and the affected plot foundation not continued.

Key:

- TP8 — Approximate Trial Pit Location (Betts Geo April 24)
- WS2 — Approximate Window Sample location (Betts Geo April 24)
- TP113 — Approximate Trial Pit Location (E3P Location March 2024)
- WS104 — Approximate Window Sample Probehole Location (E3P Location March 2024)
- CP102 — Approximate Cable Percussive Borehole Location (E3P Location March 2024)
- Anticipated Area of Existing Buildings and Existing Foundations
- Anticipated Area of Existing Foundations
- Existing Sewer Easement
- H — Plots that required Heave Protection measures
- Existing Trees
- Buried Services

Mark	Date	Details	By
P1	19/09/25	Preliminary Issue	CC

Revision history

Drawing originator:

BETTS HYDRO CONSULTING ENGINEERS · BETTS ASSOCIATES CONSULTING ENGINEERS · BETTS GEO CONSULTING ENGINEERS

Client: Keepmoat

Project title:

Cowlishaw
Oldham

Drawing title:

Foundation Zoning Plan
& Typical Foundation Details

Scale: As Indicated for the original size of A0

Drawn by: CC | Checked by: JS | Passed by: | Date: Sep 2025

Drawing status:

Preliminary

Job No:	Drawing No: Project	Origin	Volume	Level	Type	Discip.	Number	Revision:
KMH31	--	BET	00	XX	DR	S	1000	P1

Do not scale this drawing - Print in Colour

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