

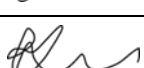
Phase 2 Geo-Environmental Investigation & Assessment

For

Amberley Drive, Wythenshawe

Undertaken on behalf of

Garden City Design and Build

Report Title:	Amberley Drive, Wythenshawe Geo-environmental Investigation and Assessment
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Revision Status / History

Rev	Date	Issue / Purpose/ Comment	Prepared	Checked	Authorised
-	03/05/2019	Final	TPB	PGD	PGD
A	27/03/2025	Updated layout and site area	-	-	TPB

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Executive Summary

Site Location	Land at Amberley Drive, Wythenshawe. It is centred on approximate Ordnance Survey National Grid Reference 381162E, 387950N with an indicative postcode of M23 2RW.
Development Proposals	Construction of 8no low-rise residential properties with associated access roads, external areas of hardstanding for parking together with private gardens.
Ground Conditions	Made ground or topsoil occurs to depths of between 0.25 and 1.30mbgl, these being locally underlain by glacial till or alluvial deposits to depths of between 0.70m and 1.75mbgl and in turn by weathered mudstone. Groundwater has been recorded at depths of between 1.13m and 1.80mbgl.
Site Preparation and Earthworks	Construction near retained trees and importantly within any RPAs should be undertaken with due regard to guidance provided in BS5837:2012 'Trees in relation to design, demolition and construction – recommendations'. The topsoil strip should be undertaken in stages and only as phased construction determines so as to prevent softening of underlying cohesive soils during wet weather conditions. Alternatively, surfaces should be excavated to fall to facilitate surface water run-off and covered with a suitably granular protective layer which will also facilitate site plant movement. Development in the southern part of the site will need to take account of existing services and associated easements. A degree of reprofiling may be required in the east of the site which may necessitate the construction of retaining walls along the eastern boundary. No cohesive soils should be used as engineered fill beneath the new structures due to the potential for continued consolidation settlement within such material. The re-use of excavated soils should be undertaken in accordance with guidance provided in the CL:AIRE Definition of Waste, Development Industry Code of Practice, Version 2, 2011 so that the activity is removed from Environmental Permitting. New/modified slopes should be stable at angles of 18 degrees. Where steeper slopes are envisaged, specific detailed analysis may be required to ensure their stability both in the short and long-term.
Foundations and Floor Slabs	New structures should be supported on traditional shallow spread foundations constructed within firm natural cohesive deposits at anticipated depths of between 1.00 and 1.50mbgl. Under such circumstances, foundations may be designed to a net allowable bearing pressure of 100kN/m². Foundations taken to greater depths and bearing wholly on less weathered mudstone may be designed on a net allowable bearing pressure of 250kN/m². Assessment as to the soil heave or shrinkage potential should be undertaken in consideration of a medium volume change classification for the clay with foundations designed to appropriate depths where such effects are envisaged. Foundation construction will need to take account of any remaining services and, where they are in close proximity, may need to be taken down to beneath the lowest level of the service trench so that their structural integrity is maintained. It is anticipated that new floor slabs may be constructed as ground bearing on natural weathered mudstone and/or glacial till deposits in the southern area of the site. The depth of made ground in the northern part of the site may require floor slabs to be suspended in the form of a beam and block construction, subject to confirmation of finished levels.
Excavations and Groundwater	Perched groundwater inflows should be anticipated at depths in excess of 1.00mbgl within excavations. Conventional 'sump and pump' dewatering measures will probably be adequate to keep excavations dry although groundwater exclusion measures such as interlocking sheet piles may be required to prevent excessive ingress of water, particularly in proximity to Mill Brook.

Pavements	New road pavement design should be based on a CBR value of no more than 2.5% in made ground and natural cohesive deposits. This would need to be reviewed and confirmed by site inspection and possibly suitable in-situ testing at formation levels following any earthwork operations and prior to pavement construction.
Concrete Classification	The typical design sulphate (DS) class and "Aggressive Chemical Environment for Concrete" (ACEC) class for the site are DS-1 and AC-1 respectively.
Soakaways	Soakaways are not considered to be a feasible drainage option for the site due to the cohesive and therefore relatively impermeable nature of underlying soils.
Ground Gas	No specific gas protection measures required.
Contamination Assessment	Analysis results indicate that made ground beneath the site contains only slightly elevated and localised levels of certain contaminants, most likely due to the presence of ash and clinker within the made ground matrix. The concentrations of contaminants are therefore not considered to be significantly hazardous to health. However, blue asbestos in the form of clumps / fibres has been encountered within 1no sample of made ground in the southern part of the site and it cannot therefore be wholly discounted that ACM and/or free fibres together with other unidentified contamination could occur within the made ground beneath other areas of the site. Therefore, where made ground is to remain in proposed garden areas, a 600mm clean cover, comprising 450mm of sub-soil and 150mm of topsoil will be required to break any exposure pathway to future site users. Where made ground is found to be relatively thin, it may prove more feasible to remove it to expose the underlying natural soil prior to placing a nominal 150mm of topsoil. All groundworks within made ground soils should be undertaken under a watching brief by an asbestos specialist with any ACM so encountered being segregated for removal to landfill. Such operations should also incorporate specific control measures such as dust suppression, perimeter air monitoring and appropriate Personal Protective Equipment (PPE). Should ACM be encountered in significant quantities, consideration should be given to providing lined service trenches and clean in-fill to prevent possible exposure during any future maintenance work. A remediation strategy will be required to bring the site to a condition suitable for the intended use by removing unacceptable risks to human health. The strategy will need to be submitted to the Local Planning Authority for their approval prior to any development commencing. The re-use of site-won topsoil and sub-soil will be subject to further testing. Slightly elevated leachable concentrations of contaminants beneath the site are not considered to pose a significant risk to groundwater or to Mill Brook with no specific environmental remedial measures necessary. However, provisions should be put in place through appropriate management of surface water run-off, to ensure that no silt or sediment enters the brook during construction.
Potable Water Supplies	Specific materials and measures to protect the water supply from ground contamination are not required.
Waste Soils	Site-won natural soil and topsoil will be suitable, subject to confirmatory analysis, for re-use as sub-soil and topsoil in garden and landscaped areas. It is likely that made ground proven not to contain asbestos would be classified as 'Non-hazardous' with natural soils classified as 'Inert' for landfill disposal. Where excavated soils, following inspection, are found to include significant concentrations of ACM and/or fibres that cannot be segregated, it may classify as Hazardous, subject to further quantification testing.

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1.0 INTRODUCTION

Appointment

- 1.1 WML Consulting has been commissioned by Garden City Design and Build to undertake a Phase 2 Geo-environmental Investigation and Assessment of a site located off Amberley Drive, Wythenshawe.

Proposed Development

- 1.2 It is understood that the proposed development will comprise the construction of 8no low-rise residential properties with associated access roads, external areas of hardstanding for parking together with private gardens.
- 1.3 The proposed development plan is presented in Appendix 01 and forms the southern section of the larger site, south of the security fence, outlined on drawing 8538G-SK01 also within Appendix 01.

Objective

- 1.4 The objective of the ground investigation and assessment was to provide geotechnical recommendations for construction design purposes together with a geo-environmental risk assessment in terms of possible ground contamination.
- 1.5 To achieve the objective, the following tasks were undertaken:
- Review the existing desk study report for the site and design a Phase 2 Ground Investigation in accordance with the Environment Agency (2004) Model Procedures for the Management of Land Contamination, CLR11, since updated to Model Procedures for Land Contamination Risk Management, updated July 2023.
 - Characterise the ground conditions in terms of geology, soil geotechnical parameters and ground contamination from information provided by the ground investigation.
 - Provide recommendations regarding suitable foundations, floor slabs and new pavement construction, together with any other geotechnical considerations that could affect possible future development.
 - Determine a ground conceptual model for the site so as to undertake an appropriate Phase 2 ground contamination Generic Quantitative Risk Assessment (GQRA).

Scope

- 1.6 A Phase 1 desk study has been undertaken and is presented in the following WML Consulting report:
- Phase 1 Desk Study and Preliminary Geoenvironmental Assessment, Reference 8538/G/01A, dated December 2018, updated March 2025.
- 1.7 This report includes the findings of a ground investigation designed on conclusions and recommendations provided in the Phase 1 Report. For ease of reference, the findings of the desk study are summarised in the following sections. The two reports however are not exclusive and should be read in conjunction.
- 1.8 The ground investigation comprised the formation of window sample probeholes undertaken with reference to BS5930:2015 Code of Practice for Ground Investigation and BS10175:2011 & A2:2017 together with A1:2013, "Investigation of Potentially Contaminated Sites - Code of Practice" except where superseded by EN ISO 22475-1 "Geotechnical Investigation and Assessment – Sampling by Drilling and Excavation and Groundwater Measurements".
- 1.9 Geotechnical soil testing has been undertaken in general accordance with guidelines provided in BS1377:1990 – Parts 1-9, "Method of Test for Soils for Civil Engineering Purposes". Samples for chemical analysis were obtained and handled generally in accordance with the current guidelines (BS10175: 2011 & A2:2017).

2.0 SITE LOCATION AND DESCRIPTION

Site Location

- 2.1 The site comprises land at Amberley Drive, Wythenshawe. It is centred on approximate Ordnance Survey National Grid Reference 381162E, 387950N with an indicative postcode of M23 2RW.
- 2.2 The proposed development site is bounded to the north, east and south by residential housing on Greenbrow Road and to the west by further residential housing off Amberley Drive.

Site Description

- 2.3 The following description describes the larger site associated with the red-line boundary within the Phase 1 report.
- 2.4 The site is undeveloped and predominantly surfaced with managed grass in use as a public open space.
- 2.5 The south-eastern and north-western sections of the site comprise linear strips of mature deciduous trees and very dense vegetation along the line of Mill Brook, which extends roughly north-west to south-east through the site.
- 2.6 Further sporadic mature deciduous trees are located across the managed grassland in the north-eastern section.
- 2.7 The northern section of the site is accessed through a metal security gate from the end of the recently constructed properties on Amberley Drive, where an asphalt access track extends over a small culverted section of Mill Brook.
- 2.8 The southern area of the site is openly accessible from Amberley Drive, which forms the western site boundary.
- 2.9 A metal security fence extends north-east to south-west across the central section of the site.
- 2.10 Mill Brook is also noted to be culverted just beyond the northern apex of the site, from where the culvert appears to extend beneath Portslade Walk to the north-west.
- 2.11 The surrounding land is mainly developed for residential use with localised areas of public open space with Wythenshawe Hospital some 200m to the west.

3.0 SUMMARY OF ENVIRONMENTAL AND HISTORICAL SETTING

3.1 The following paragraphs summarise the most relevant findings of the Phase 1 desk study report.

Geology

3.2 British Geological Survey (BGS) plans indicates drift deposits to be absent beneath the majority of the site. However, the north-western section is indicated to be underlain by Devensian Glacial Till. Solid strata are represented by Triassic Bollin Mudstone.

3.3 In consideration of the underlying geology, risks of subsidence from coal mining can be discounted.

Radon

3.4 The property is not in a radon affected area as defined by the BGS/UK Health Security Agency where less than 1% of properties are above the action level of exposure. Therefore, no radon protection measures are necessary for new structures as described in publication BR211 by the Building Research Establishment.

Environmental Setting

3.5 The Glacial Till beneath the north-western section of the site is classified as a "Secondary (Undifferentiated) Aquifer". The underlying Bollin Mudstone is classified as a "Secondary (B) Aquifer".

3.6 The site is not in an Environment Agency (EA) Source Protection Zone (SPZ) and there are no groundwater abstractions located within 500m of the site. Mill Brook extends roughly north-west to south-east through the centre of the site.

3.7 There are no active or historic landfills recorded within 500m of the site.

3.8 There are 2no electricity sub-stations located 18m south-west and 90m north-west of the site.

Site History

3.9 The earliest maps dated 1876 indicate the site to comprise undeveloped woodland and agricultural land bordering Mill Brook, which extended roughly north-west to south-east through the central section. Greenbrow Lane extended roughly north-west to south-east across the north-eastern section of the site.

3.10 The surrounding area originally comprised undeveloped rural / agricultural land with occasional small field ponds, woodlands and localised residential structures.

3.11 By 1960 a section of Mill Brook was culverted at the northern apex of the site. This coincided with the construction of a small bridge providing access across Mill Brook in the central section of the site. Although the site has since remained undeveloped public open space, by this time the area immediately surrounding the site had been developed for residential housing.

4.0 PRELIMINARY CONTAMINATION RISK ASSESSMENT

- 4.1 Based on the above findings, the Phase 1 desk study report concluded that pollution linkages were either not envisaged or considered unlikely with the overall preliminary contamination risk assessed as very low to low.
- 4.2 However, the report recommended that assumptions in the conceptual model be verified by providing information on the physical and chemical ground conditions through appropriate site investigations.
- 4.3 The investigations were to comprise sampling and chemical analysis of the near surface soil and possibly groundwater and the possible installation of ground gas monitoring standpipe with subsequent monitoring for hazardous ground gas concentrations and flow where considered necessary.
- 4.4 In addition, appropriate investigations were to be undertaken to establish geotechnical parameters for the design of foundations, floor slabs and pavement construction.

5.0 SITE INVESTIGATION

- 5.1 Since the issue of the Initial Investigation the red line boundary has been amended. However, the following descriptions apply to the red-line boundary within the Phase 1 report unless otherwise specified.

Rationale

- 5.2 Intrusive investigations were undertaken primarily to provide geotechnical parameters for structural design purposes but also to verify the preliminary site conceptual model and confirm the anticipated low environmental risk.
- 5.3 Window sample probeholes were undertaken to provide information on near surface deposits and to obtain samples for chemical analysis.
- 5.4 A general coverage of the site was considered appropriate although the investigation locations were also chosen so as not to impact on the presence of known/suspected services beneath the site.
- 5.5 Monitoring standpipes were installed in selected probeholes for the measurement of ground gas and groundwater levels.
- 5.6 Chemical analysis of a general suite of contaminants was undertaken on selected samples of soil. This was to confirm the anticipated low contamination risk and to establish the chemical suitability of soils for possible re-use within the development.

Intrusive Works

- 5.7 Ground investigation work was undertaken by LOT Geotechnics Ltd on the 15th and 22nd March 2019. This comprised the formation of 12no window sample probeholes to a maximum depth of 2.70 metres below ground level (mbgl).
- 5.8 The exploratory hole records are presented in Appendix 02 of this report whilst the exploratory hole locations are shown on sketch Drawing 8538G-SK01 in Appendix 01.

Monitoring Standpipes

- 5.9 Monitoring wells for groundwater and ground gas measurements were installed in 6no probeholes as indicated on the logs presented in Appendix 02 with WS09, WS10 and WS11 within the currently proposed development area.

Geotechnical and Chemical Testing

- 5.10 In-situ geotechnical testing was undertaken at regular intervals during the formation of the probeholes in the form of Standard Penetration Tests (SPTs). The results for this testing are presented on the descriptive logs in Appendix 02.
- 5.11 Geotechnical soils testing was undertaken on selected samples for the following:
- Natural Moisture Content.
 - Liquid and Plastic Limit.
- 5.12 The results of the geotechnical testing are presented in Appendix 03.
- 5.13 Chemical analysis was undertaken on selected soil samples for the following contaminants of concern:
- Total Arsenic, Boron, Cadmium, Chromium VI, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc.

- Total Cyanide, Phenols, Sulphur, Sulphate.
- Speciated USEPA Polyaromatic Hydrocarbons (PAH).
- Asbestos Screen and Identification.
- 2:1 water/soil sulphate extract, pH.

5.14 Leachate analyses was also undertaken on selected samples of shallow soils due to the proximity of the brook, for the following contaminants of concern.

- Total Arsenic, Boron, Cadmium, Chromium VI, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc.
- Total Cyanide, Phenols, Sulphur, Sulphate.
- Speciated USEPA Polyaromatic Hydrocarbons (PAH).
- 2:1 water/soil sulphate extract, pH.
- Water hardness.

5.15 The results of the chemical analysis are presented in Appendix 04.

Gas and Groundwater Monitoring

5.16 Gas and groundwater monitoring has been carried out on 2no occasions, to date, on 3rd and 9th April 2019. The monitoring results are presented in Appendix 05.

6.0 GROUND CONDITIONS

Stratigraphy

- 6.1 Ground conditions encountered during the intrusive investigation comprise made ground or topsoil to depths of between 0.25m and 1.30mbgl, these being locally underlain by glacial till or alluvial deposits to depths of between 0.70m and 1.75mbgl and in turn by weathered Bollin Mudstone.

Topsoil

- 6.2 Topsoil was encountered within all of the exploratory holes in the southern and central parts of the site, namely WS05 to WS12 inclusively, from ground level to depths of between 0.20m and 0.40mbgl.
- 6.3 The topsoil generally comprised dark brown, slightly gravelly, clayey sand with rootlets. Gravel sized fragments included sandstone.

Made Ground

- 6.4 Made ground was encountered mainly in the exploratory holes located in the northern part of the site, namely WS01 to WS04 inclusive WS07 and WS10, from ground level to depths generally between 0.40m and 1.30mbgl.
- 6.5 The made ground generally comprised dark brown, slightly gravelly, clayey sand and sandy clay. Gravel sized particles included sandstone, brick and more locally glass, metal, clinker and ash.
- 6.6 Within WS02 and WS07 in the northern part of the site, a horizon of granular made ground was encountered at 0.65m and 0.10mbgl respectively, extending to 1.10m and 0.35mbgl respectively. This comprised dark grey, slightly sandy gravel of ash and clinker.
- 6.7 Within WS10 in the southern part of the site, a very thin (0.05m) horizon of ash and clinker was encountered underlying the topsoil at a depth of 0.30m.

Alluvial Deposits

- 6.8 Within WS08, located adjacent to Mill Brook in the northern part of the site, soil considered to represent alluvium was encountered at a depth of 0.30mbgl and extending to 1.45mbgl.
- 6.9 This comprised soft to firm, orange brown to brown and grey, slightly silty, sandy clay with pockets of clayey sand.
- 6.10 A single SPT 'N' value within the cohesive deposits of 11 confirmed the generally firm consistency at this depth.

Glacial Till

- 6.11 Within the majority of the exploratory holes in the northern part of the larger site, namely WS01, WS03, WS05, WS06 & WS07, glacial till was encountered underlying the made ground at depths of between 0.25m and 0.80mbgl. The till extended to depths of between 0.70m and 1.75mbgl.
- 6.12 This generally comprised firm, orange brown, slightly silty, slightly gravelly, sandy clay. Gravel sized particles included sandstone, siltstone and mudstone.
- 6.13 SPT 'N' values within the glacial till ranged between 9 and 13 with an average of 11 indicating a generally firm consistency.

- 6.14 Natural moisture contents of 14% and 20% were recorded within the glacial till with liquid limits of 33% and 35% together with corresponding plasticity indices of 17% and 18% (modified to 15% and 17%) indicating clay of low to intermediate plasticity and low volume change potential.

Bollin Mudstone

- 6.15 Within all of the exploratory holes, the superficial deposits were underlain by strata considered to represent completely weathered Bollin Mudstone at depths of between 0.20m and 1.45mbgl and extending to a maximum proven depth of 2.70mbgl.
- 6.16 The upper horizons of the mudstone were completely weathered to the consistency of a soil and recovered as red to orange brown, locally sandy, variably silty clay, locally with mudstone lithorelicts.
- 6.17 Solid strata was encountered within the majority of exploratory holes at depths of between 1.30m and 1.80mbgl. This generally comprised extremely weak, reddish brown and occasionally grey mottled, moderately weathered mudstone.
- 6.18 SPT 'N' values within the completely weathered mudstone generally ranged between 4 and 46 with an average of 19 indicating a consistency mainly of firm to stiff but locally with softer zones.
- 6.19 SPT 'N' values within the less weathered mudstone were generally in excess of 50 confirming a solid state.
- 6.20 Natural moisture contents of 20% and 24% were recorded within the completely weathered mudstone with liquid limits of 37% and 40% together with corresponding plasticity indices of 19% and 21% (modified to 18% and 20%) indicating clay of intermediate plasticity and low to medium volume change potential.

Visual/Olfactory Evidence of Contamination

- 6.21 No visual and/or olfactory evidence of significant ground contamination was identified within the exploratory holes during the investigation.

Groundwater

- 6.22 Groundwater seepages were encountered during the formation of WS02 within the made ground and WS08 within alluvial deposits, both at depths of 1.00mbgl.
- 6.23 During the initial monitoring visits, standing water was recorded at depths of between 1.13m and 1.80mbgl.
- 6.24 It should be appreciated that the groundwater monitoring described above has been undertaken during a very short period of time. Significant variations in the long term groundwater regime may occur at other times, particularly with prolonged, extreme weather conditions, and that no account can be taken of such in this report.

General

- 6.25 It should also be appreciated that ground conditions may vary between and away from the exploratory hole positions, and that no account can be taken in this report of such variations.

7.0 GEOTECHNICAL APPRAISAL

Site Preparation and Earthworks

- 7.1 As part of the site clearance, the removal of any trees and other vegetation should be undertaken in consultation with an ecological specialist.
- 7.2 Where trees are to be retained, development will need to take account of Root Protection Areas (RPAs) such as would need to be determined by the landscape architect and/or arboriculturalist.
- 7.3 Notwithstanding this, construction near retained trees and importantly within any RPAs should be undertaken with due regard to guidance provided in BS5837:2012 'Trees in relation to design, demolition and construction – recommendations'.
- 7.4 Topsoil stripped from areas of redevelopment should be stockpiled and protected from inclement weather where considered suitable for future use in garden and landscaped areas, following confirmatory laboratory testing.
- 7.5 Cohesive strata beneath the site are likely to prove sensitive to moisture change and may become softened if exposed, particularly during wet weather conditions. Where possible, the site strip should therefore be undertaken in stages and only as phased construction determines.
- 7.6 Where this is not possible and there is a requirement to expose the cohesive strata for any appreciable time, surfaces should be excavated to fall to facilitate surface water run-off and covered with a suitably granular protective layer which will also facilitate site plant movement.
- 7.7 Development in the southern part of the site will need to take account of existing services and associated easements.
- 7.8 The site has remained undeveloped therefore no significant ground obstructions such as buried structures are envisaged.
- 7.9 No significant earthworks are anticipated although a degree of reprofiling may be required in the east of the site which may necessitate the construction of retaining walls along the eastern boundary.
- 7.10 Excavated cohesive soils could be considered suitable for re-use as bulk fill, subject to moisture control and confirmatory testing. However, no cohesive soils should be used as engineered fill beneath the new structures due to the potential for continued consolidation settlement within such material.
- 7.11 It should be noted that the re-use of excavated soils on site should be undertaken in accordance with guidance provided in the CL:AIRE Definition of Waste, Development Industry Code of Practice, Version 2, 2011 so that the activity is removed from Environmental Permitting. In this respect, surplus materials will cease to be waste where it can be demonstrated that there is a certainty to their use and that only the quantities necessary for that purpose are used.
- 7.12 Any new/modified slopes should be stable at angles of up to 1 vertical in 3 horizontal (18 degrees). Where steeper slopes are envisaged, specific detailed analysis may be required to ensure their stability both in the short and long-term.
- 7.13 Suitable crest, toe and slope drainage will need to be incorporated into any new slopes and/or retaining structures constructed at the site.

Foundations

- 7.14 Localised areas of made ground and soft natural strata should be considered unsuitable for the direct support of structural loads as they could result in unacceptable total and differential settlements.

- 7.15 New structures should therefore be supported on traditional shallow spread foundations constructed within firm natural cohesive deposits at anticipated depths of between 1.00m and 1.50mbgl. Under such circumstances, foundations may be designed to a net allowable bearing pressure of 100kN/m².
- 7.16 All formations will need to be carefully inspected to confirm the anticipated soil strength. Any soft/loose or otherwise incompetent soils so encountered should be excavated and replaced with foundation concrete.
- 7.17 Foundations taken to greater depths and bearing wholly on less weathered mudstone may be designed on a net allowable bearing pressure of 250kN/m².
- 7.18 Where spread foundations and floor slabs bearing on clay soils are to be constructed in close proximity to existing or removed trees, identification of the tree species will be required to determine its water demand as provided in Appendix 4.2-A of NHBC Standards 2010, Foundations, Chapter 4.2, Building Near Trees. Assessment as to the soil heave or shrinkage potential should then be undertaken in consideration of a medium volume change classification for the clay with foundations designed to appropriate depths where such effects are envisaged.
- 7.19 Foundation construction will need to take account of any remaining services and, where they are in close proximity, may need to be taken down to beneath the lowest level of the service trench so that their structural integrity is maintained.

Floor Slabs

- 7.20 Given the relatively shallow nature of the made ground and topsoil in the southern part of the site it is anticipated that new floor slabs may be constructed as ground bearing on natural weathered mudstone and/or glacial till deposits.
- 7.21 Formations in such areas will need to be carefully inspected to confirm the anticipated soil strength with any soft/loose or otherwise incompetent soils so encountered being excavated and replaced with well compacted granular fill.
- 7.22 The depth of made ground in the northern part of the site may require floor slabs to be suspended in the form of a beam and block construction, subject to confirmation of finish levels.

Excavations and Groundwater

- 7.23 Excavations at the site will be feasible using conventional hydraulic plant. All excavations at the site requiring man-entry will need adequate lateral support, or will need to be battering back to a safe angle to ensure their stability.
- 7.24 Perched groundwater inflows should be anticipated at depths in excess of 1.00mbgl within excavations. Conventional 'sump and pump' dewatering measures will probably be adequate to keep excavations dry although it cannot be discounted that groundwater exclusion measures such as interlocking sheet piles may be required to prevent excessive ingress of water, particularly in proximity to Mill Brook.

Pavement Design

- 7.25 In consideration of the ground conditions, it is recommended that new road pavement design should be based on a California Bearing Ratio (CBR) value of no more than 2.5% in made ground and natural cohesive deposits.
- 7.26 The CBR would need to be reviewed and confirmed by site inspection and possibly suitable in-situ testing at formation levels following any earthwork operations and prior to pavement construction.

Concrete Design

- 7.27 Design/mix of buried concrete should be undertaken in accordance with the "Aggressive Chemical Environment for Concrete" (ACEC) classification, of BRE Special Digest 1:2005 (Concrete in Aggressive Ground). With reference to the site history, it is deemed appropriate to classify the site as "Brownfield", with respect to BRE Special Digest.
- 7.28 Values of 2:1 water/soil extract for sulphate for soils do not exceed 69mg/l. Values of pH at foundation depth range from 7.6 to 8.2 indicating near neutral to slightly alkaline conditions.
- 7.29 On the basis of these results, the typical design sulphate (DS) class and "Aggressive Chemical Environment for Concrete" (ACEC) class for the site are DS-1 and AC-1 respectively.

Drainage and Soakaways

- 7.30 In consideration of the site being underlain by relatively impermeable cohesive deposits, soakaways are not considered to be a feasible drainage option for the site.

8.0 GENERIC QUANTITATIVE RISK ASSESSMENT (GQRA)

General

- 8.1 A review of the desk study information has concluded that the potential for a significant pollution linkage to be present at the site is low with corresponding low risk to human health and the environment.
- 8.2 No visual or olfactory evidence of significant ground contamination has been recorded from the intrusive investigations although made ground was recorded within probeholes particularly in the north of the site.
- 8.3 It has therefore been considered prudent to adopt a precautionary principal and undertake chemical analysis of the sub-surface soils to establish in more detail the human health risk status of the site.
- 8.4 Selected samples have also been analysed for leachable contaminants in view of the proximity of the development to Mill Brook.

Human Health

- 8.5 Selected samples have been analysed for a general suite of contaminants of concern and compared against Screening Levels (SL's) for human health to determine the significance of the measured concentrations in relation to the site conceptual model. Thus, a Generic Quantitative Risk Assessment has been undertaken in line with guidelines provided in CLR11, Model Procedures for the Management of Land Contamination, 2004.GQRA, since updated to Model Procedures for Land Contamination Risk Management, updated July 2023.
- 8.6 The criteria for a limited number of contaminants have been derived by DEFRA in their document entitled SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, April 2014.
- 8.7 Within the document, Category 4 Screening Levels (C4SL's) are described as being more pragmatic than previous screening criteria and represent concentrations in soil that present an 'acceptable' level of risk within the context of Part 2A.
- 8.8 The National Planning Policy Framework states that 'after development, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990'. Therefore by inference, the C4SL's are appropriate for use in the planning context.
- 8.9 Although the SP1010 document states that C4SL only apply for a 'sandy loam soil with 6% soil organic matter', it is generally accepted that assessment criteria for metals are not sensitive to changes in soil organic content (SOM). The C4SL's have therefore been adopted as assessment criteria in this report for the listed metals within the SP1010.
- 8.10 Subsequent to SP1010, LQM/CIEH have published a document entitled 'The LQM/CIEH S4ULs for Human Health Risk Assessment' 2015. In brief, the document provides updated assessment criteria which have been derived in accordance with UK legislation, national as well as EA policy and using a modified version of the CLEA software and available guidance. The new screening criteria, or Suitable 4 Use Levels (S4ULs), are intended to provide a complete and updated replacement to the previous LQM/CIEH GAC of 2009. As such they are considered appropriate for use in this assessment for other contaminants not covered by C4SL's and/or for organic contaminants assuming a worst-case Soil Organic Matter (SOM) of 1% as an initial conservative assessment.
- 8.11 For each contaminant, S4UL's and C4SL's have been calculated for six land use scenarios, namely:
- Residential with homegrown produce.
 - Residential without homegrown produce.
 - Allotments.

- Commercial.
- Public Open Space near residential housing.
- Public Parks (remote from residential housing).

8.12 In light of the proposed development, the SL's for a "Residential with homegrown produce" end-use are considered appropriate for a conservative assessment at this stage.

8.13 A table of relevant SL's protective of human health for both 1% and 2.5% SOM are provided in Appendix 06.

Controlled Waters

8.14 Generic criteria for the assessment of potential groundwater/surface water contamination have been derived from very conservative guidelines protective of drinking water and environmental quality, namely:

- UK Environmental Quality Standards (EQS) for Freshwater, 2000;
- Petroleum Products in Drinking-water, Background document for development of WHO Guidelines for Drinking-water Quality, 2011 (assuming a water hardness, based on laboratory testing of 50-200 ug/l).

8.15 A table of relevant SL's protective of controlled waters is provided in Appendix 06.

Soil Test Results

8.16 10no soil samples (6no of made ground and 4no of topsoil) were analysed for a suite of Contaminants of Concern (CoC).

8.17 With the exception of 1no sample with an Organic Matter Content (OMC) of 2.2%, OMC for remaining samples range from 7.6% to 29% (average 11.3%). It has therefore been considered appropriate to adopt SL's relating to a 2.5% SOM in the generic assessment.

8.18 The majority of the concentrations measured were below the SL's for "Residential with homegrown produce", assuming an SOM of 2.5%, with the following exceptions.

Contaminant	Number of Exceedances	SL (mg/kg)	Recorded Concentrations (mg/kg)	Samples
Mercury	1	1.2	3.8	WS02 – 0.30m
Lead	2	200	270 – 400	WS02 – 0.30m WS04 – 0.30m
Dibenz[a,h]anthracene	2	0.28	0.32 – 0.46	WS02 – 0.30m WS07 – 0.20m

8.19 All concentrations exceeding the SL's were in samples of made ground.

8.20 Crocidolite (blue) asbestos fibres / clumps were detected in 1no of the sample of made ground, namely WS10 at 0.30mbgl.

Leachate Test Results

8.21 3no soil samples, namely WS01, WS02 and WS07, were submitted for the analysis of leachable concentrations of metals, semi-metals and PAH compounds.

- 8.22 The majority of the results were below the generic criteria when compared to the EQS for freshwater, and the more stringent UKDWS, with the following minor exceedences.

Contaminant	Ref Value ug/l		Exceedances ug/l		Sample
	EQS	UKDWS	EQS	UKDWS	
Arsenic	50	10	-	19	WS07 – 0.90m
Copper	3	2000	5.1 – 8.7	-	WS01 – 0.40m WS07 – 0.90m
Lead	10	10	12	12	WS07 – 0.90m

Discussion and Conclusions

Risks to Human Health

- 8.23 Analysis results indicate that made ground beneath the site contains only slightly elevated and localised levels of certain contaminants that are elevated above their respective SL's. These relate to mercury, lead and the PAH compound dibenzo[a,h]anthracene, most likely due to the presence of ash and clinker within the made ground matrix. The concentrations of contaminants are therefore not considered to be significantly hazardous to health.
- 8.24 However, blue asbestos in the form of clumps / fibres have been encountered within 1no sample of made ground in the southern part of the site, namely WS10 at 0.30mbgl.
- 8.25 As such, it cannot be wholly discounted that ACM and/or free fibres together with other unidentified contamination could occur within the made ground beneath other areas of the site.
- 8.26 Following site development, where surfaced with buildings and hardstanding, there will be no mechanism for a direct contact pollution linkage with any unidentified contaminants or for any asbestos fibres to become airborne. Therefore, the risk to end-users and to the general public will be negligible in such areas.
- 8.27 However, an exposure scenario is possible in garden areas which are directly underlain by made ground. Therefore, where made ground is to remain in proposed garden areas, a 600mm clean cover, comprising 450mm of sub-soil and 150mm of topsoil will be required to break any exposure pathway to future site users.
- 8.28 Where made ground is found to be relatively thin, it may prove more feasible to remove it to expose the underlying natural soil prior to placing a nominal 150mm of topsoil.
- 8.29 Notwithstanding the above, as there is a low possibility of asbestos fibres becoming airborne during site enabling and ground works, there is a perceived risk to construction workers and the general public of exposure, particularly during dry weather conditions.
- 8.30 All groundworks within made ground soils should therefore be undertaken under a watching brief by an asbestos specialist with any ACM so encountered being segregated for removal to landfill. Such operations should also incorporate specific control measures such as dust suppression, perimeter air monitoring and appropriate Personal Protective Equipment (PPE).
- 8.31 Should ACM be encountered in significant quantities, consideration should be given to providing lined service trenches and clean in-fill to prevent possible exposure during any future maintenance work.

- 8.32 In consideration of the above, it is anticipated that a remediation strategy will be required to bring the site to a condition suitable for the intended use by removing unacceptable risks to human health. The strategy will need to be submitted to the Local Planning Authority for their approval prior to any development commencing.
- 8.33 The re-use of site-won topsoil and sub-soil will be subject to further testing and may require production of a site-specific Materials Management Plan.

Risks to Controlled Waters

- 8.34 Slightly elevated leachable concentrations of arsenic and lead were recorded within a single sample of made ground when compared to the stringent drinking water standards. In addition, when the results were compared against the EQS values for surface water, slight exceedances of copper were recorded in 2no samples of made ground.
- 8.35 Taking into consideration that the site is not within an EA Source Protection Zone and there are no groundwater / surface water abstractions recorded within influencing distance, the slightly elevated concentrations are not considered to pose a significant risk to controlled waters.
- 8.36 Furthermore, the site will include a positive drainage system which will intercept a significant volume of surface water runoff, thus significantly reduce the potential for contaminants to leach and become mobile.
- 8.37 Therefore, recorded contaminants beneath the site are not considered to pose a significant risk to groundwater or to Mill Brook with no specific environmental remedial measures necessary.
- 8.38 Notwithstanding this, provisions should be put in place through appropriate management of surface water run-off, to ensure that no silt or sediment enters the brook during construction.

9.0 GROUND GAS RISK ASSESSMENT

Methodology

- 9.1 Current guidance for the assessment of risk associated with the presence of hazardous ground gases (principally methane and carbon dioxide) is provided in two key documents, namely:
- Code of practice for the Characterisation and remediation from Ground Gas in Affected Developments. British Standard Institution (BS 8485: 2015); and
 - Assessing Risks posed by Hazardous Ground Gases to Buildings CIRIA (C665, 2007).
- 9.2 The assessment presented herein is primarily based on the BS8485 document.
- 9.3 Hazardous ground gas qualitative risk assessment is based on a conceptual model similar to that used for soil and groundwater contamination sources (i.e., source-pathway-receptor pollutant linkages). A semi-quantitative estimate of risk can be assessed based on knowledge of the conceptual model and a measure of hazardous gas concentration and gas flow at the site within monitoring standpipes.
- 9.4 Based on the measured flow rates and hazardous gas concentrations, individual "hazardous gas flow rates" (Qhg) can be derived for each monitoring point, from which the "site characteristic hazardous gas flow rate" (Qhgs), and then the "Characteristic Situation" (CS) can be determined.
- 9.5 BS8485 provides guidance on the level of gas protection requirements based upon the characteristic situation and the proposed development based on building type as outlined in Table 3.

Table 3 - Building Types

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ Public, possible multiple	Commercial / Public	Commercial / Industrial
Control (Change of use)	None	Some but not all	Full	Full
Room Sizes	Small	Small/ medium	Small to Large	Large Industrial/ Retail Park

- 9.6 The proposed development is indicated to comprise the construction of **Type A** buildings, the definition of which is provided in BS8485:2015 as:
- *Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present.*

Ground Gas Conceptual Model

- 9.7 The site is not located in an area where radon protection measures are required.
- 9.8 There are no current or historic landfills within influencing distance of the site.
- 9.9 No appreciable thickness of made ground from historical in-filling has been encountered beneath the site.
- 9.10 The presence of ground gas resulting from shallow unrecorded mine workings can be discounted.

- 9.11 Organic Alluvial deposits with the potential to generate ground gas could be encountered adjacent to Mill Brook but are unlikely to be significant in thickness or extent.
- 9.12 The ground gas generation potential for the site is therefore 'Very low' in accordance with BS8576:2013 Guidance on investigation for ground gas – Permanent gases and Volatile Organic Compounds (VOCs).
- 9.13 However, it has been considered prudent to undertake monitoring, primarily for methane and carbon dioxide, with associated flow rates, on six occasions between 3rd April and 26th June 2019.

Results and Recommendations

- 9.14 The results to date indicate that methane concentrations do not exceed 0.1% by volume in air (v/v) with peak carbon dioxide concentrations ranging between 0.3% and 6.5% v/v.
- 9.15 However, carbon dioxide exceeding 5% v/v occurred only within WS01 and WS03 on three of the six locations. However, it is noted that these are located outside the current development area depicted in the layout within Appendix 01. Therefore, are not considered within the current assessment.
- 9.16 No detectable ground gas flows have been recorded during the initial monitoring visits.
- 9.17 Therefore based on the results within the current subject site area, namely WS09, WS10 and WS11, give a maximum Q_{hg} value of <0.006l/hr (0.1l/hr flow and 2.3% carbon dioxide) and indicate the site to classify as Characteristic Situation (CS) 1 – Very Low Gas Risk', with no specific gas protection measures required.

10.0 OTHER POTENTIAL DEVELOPMENT CONSIDERATIONS

Excavated Soils

- 10.1 Groundworks undertaken during the development will produce excavated soil which will require appropriate site management. Principally, and in line with the sustainable development agenda, any soils arising from site excavations should firstly be considered for re-use where possible by incorporation into the development.
- 10.2 Waste arisings comprising natural soil and topsoil will be suitable, subject to confirmatory analysis, for re-use as sub-soil and topsoil in garden and landscaped areas.
- 10.3 Where soils are surplus to requirements, they will need to be removed from site through appropriate waste management.
- 10.4 It should be noted that the chemical analysis results for disposal classification are assessed against different assessment criteria to those relating to contamination risk assessment. Soils that are deemed suitable for use in terms of risk to human health and the environment may not necessary be uncontaminated and could be classified as 'Non-Hazardous' or even Hazardous' for disposal purposes.
- 10.5 For preliminary guidance based on the current information, it is likely that made ground proven not to contain asbestos would be classified as 'Non-hazardous' with natural soils classified as 'Inert' for landfill disposal.
- 10.6 However, where excavated soils, following inspection, are found to include significant concentrations of ACM and/or fibres that cannot be segregated, it may classify as Hazardous, subject to further quantification testing.
- 10.7 It will be the responsibility of the waste producer to undertake testing and classification of any waste soils for disposal to an appropriately licenced landfill in accordance with current guidelines and Duty of Care requirements.

Imported Fill

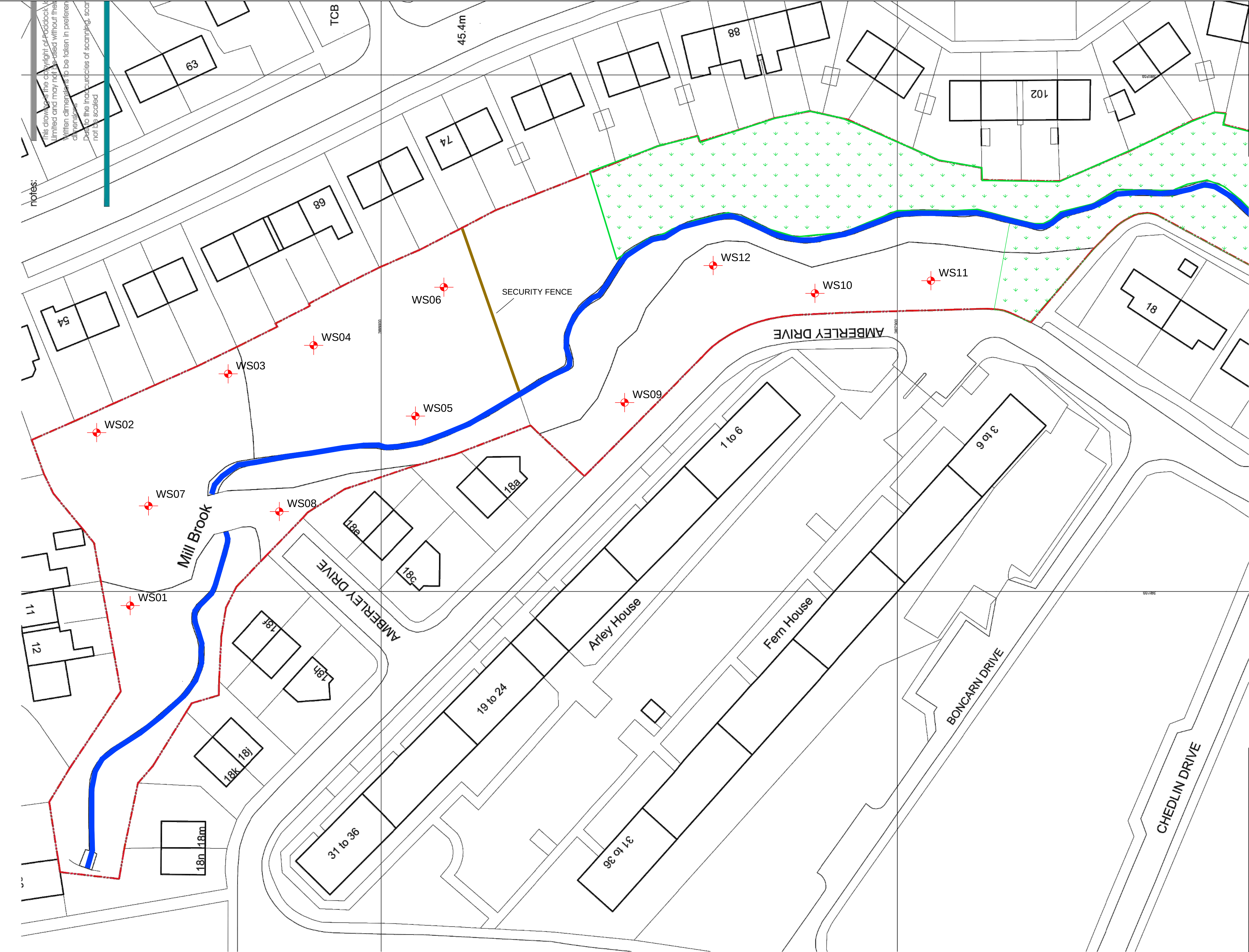
- 10.8 Imported fill will be subject to specific quality requirements and should be accompanied by appropriate certification to confirm its suitability. Allowance should also be made for testing imported fill materials prior to placement to ensure suitability.

Water Supply Pipes

- 10.9 The utilities supplier will need to be consulted with regards the selection of suitable water supply pipe materials for the development. In light of the ground conditions encountered at anticipated water pipe depths, specific materials and measures to protect the water supply from ground contamination are not required.

APPENDIX 01

Drawings



notes:
This drawing is the copyright of Prodoct & Co. Limited and may not be used without their written permission.
Dimensions to be taken in preference to the dimensions shown on the drawing.
Due to the inaccuracies of scanning, scale may not be scaled.

GENERAL NOTES

- DO NOT SCALE FROM THIS DRAWING WORK TO FIGURED DIMENSIONS ONLY.
- NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS ALLOWED WITHOUT PRIOR PERMISSION IN WRITING.
- ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL ARCHITECTS, ENGINEERS AND SPECIALISTS DRAWINGS AND THE SPECIFICATION.
- THE CONTRACTOR SHALL INCORPORATE ALL THE REQUIREMENTS OF THE PRE-TENDER STAGE HEALTH & SAFETY PLAN.

KEY

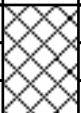
- SITE BOUNDARY
- MILL BROOK
- WS1 PROBEHOLE LOCATION
- LANDSCAPING TO BE RETAINED

P1	FIRST PRELIMINARY ISSUE.	APR 19	SS	PD
Rev.	Amendment	Date	By	Chkd
Project AMBERLEY DRIVE				
Client GARDEN CITY DESIGN AND BUILD				
Title EXPLORATORY HOLE LOCATION PLAN				
Drawn SS	Checked PD	Date 10-04-19	Scale 1:750@A3	
WML CONSULTING Chartered Civil and Structural Engineers		No.8 Oak Green Earl Road Stanley Green Business Park Cheadle Hulme Cheshire SK9 6QL Tel 0161 482 0600 Fax 0161 486 9210 e-mail info@wmlconsulting.com www.wmlconsulting.com		
Job No. 8538G		Drawing No. SK-01 P1		

APPENDIX 02

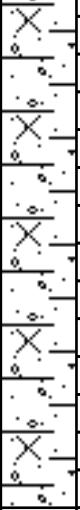
Exploratory Hole Records

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		Project Number: 8538G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 15/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.20	E					Turf over dark brown, slightly gravelly, clayey SAND with rootlets. Gravel is subangular to subrounded, fine to coarse, including brick, ash, clinker, glass and sandstone. (MADE GROUND)		
0.40	ES							
1.00	D	N=13			0.60	Firm, orange brown, slightly silty, slightly gravelly, sandy CLAY. Gravel is subangular, fine to coarse, including sandstone and mudstone. (GLACIAL TILL)		
					1.00			
					1.30	Firm to stiff, reddish brown, silty CLAY with mudstone lithorelicts. (WEATHERED BOLLIN MUDSTONE)		
					1.80			
		N=37			2.00	Extremely weak, reddish brown and occasionally grey mottled, moderately weathered MUDSTONE. (BOLLIN MUDSTONE)		
					2.60			
		pp 50/210mm			3.00	End Of Borehole At 2.60 m		

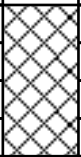
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level		REMARKS No Groundwater Encountered Refused at 2.60mbgl. 		Water Strikes																									
				<table border="1"> <thead> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>						Date	Strike	Level	Minutes	Casing	Sealed														
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Date	Casing	Water	From	To	Hours																								

		Project Title: Amberley Drive				WS02	
		Project Number: 8538G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 15/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.30	E	N=8				Turf over dark brown, slightly gravelly, clayey SAND with rootlets. Gravel is subangular, fine to coarse, including brick, ash and sandstone. (MADE GROUND)		
0.70	ES				0.65	Dark grey, slightly sandy, subangular, fine to coarse GRAVEL, including ash and clinker. (MADE GROUND)		
					1.00 1.10 1.30	Dark grey, sandy, gravelly CLAY. Gravel is subangular, including ash and clinker. (MADE GROUND)		
1.50	J	N=35				Firm, becoming stiff, reddish brown, silty CLAY with mudstone lithorelicts. (WEATHERED BOLLIN MUDSTONE)		
		N=46			2.00 2.70	End Of Borehole At 2.70 m		
					3.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level 		REMARKS Refused at 2.70mbgl. Scale: 1:20		Water Strikes					
				Date	Strike	Level	Minutes	Casing	Sealed
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		Daily Log Of Depths				Chiselling			
		Date	Casing	Water	From	To	Hours		

		Project Title: Amberley Drive				WS03	
		Project Number: 8538G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 15/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.10	E	N=15 sb 50/145mm			0.40	Turf over dark brown, slightly gravelly, sandy CLAY with rootlets. Gravel is subangular, fine to coarse, including brick, ash, clinker, metal and mudstone. (MADE GROUND)		
					1.00	Firm, orange brown, slightly silty, slightly gravelly, sandy CLAY. Gravel is subangular, fine to coarse, including sandstone. (GLACIAL TILL)		
1.10	D				1.40	Firm to stiff, reddish brown, silty CLAY with mudstone lithorelicts. (WEATHERED BOLLIN MUDSTONE)		
					1.60	Extremely weak, reddish brown and occasionally grey mottled, moderately weathered MUDSTONE. (BOLLIN MUDSTONE)		
						End Of Borehole At 1.60 m		
					2.00			
					3.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level		REMARKS No Groundwater Encountered Refused at 1.60mbgl. 		Water Strikes																									
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WML CONSULTING			Project Title: Amberley Drive				WS04																																														
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Date: 15/03/2019			Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB																																														
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe																																													
0.30	E	N=7				Turf over dark brown, slightly gravelly, clayey SAND with rootlets. Gravel is angular to subangular, fine to coarse, including brick, ash, metal, plastic and sandstone. Low cobble content. Cobbles are subangular, including brick and sandstone. (MADE GROUND)																																															
						1.00																																															
						1.30																																															
1.50	J	N=56			1.70	Firm, reddish brown, silty CLAY with mudstone lithorelicts. (WEATHERED BOLLIN MUDSTONE)																																															
						2.00	Extremely weak, reddish brown and occasionally grey mottled, moderately weathered MUDSTONE. (BOLLIN MUDSTONE)																																														
						2.00	End Of Borehole At 2.00 m																																														
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		Project Number: 8538G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 15/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
		N=11			0.25	Turf over dark brown, slightly gravelly, clayey SAND with rootlets. Gravel is subangular, fine to coarse, including sandstone. (TOPSOIL)		
				0.70	Firm, orange brown, slightly silty, slightly gravelly, sandy CLAY. Gravel is subangular, fine to coarse, including sandstone. (GLACIAL TILL)			
				1.00	Firm, reddish brown, silty CLAY with mudstone lithorelicts. (WEATHERED BOLLIN MUDSTONE)			
				1.40				
				2.00	Extremely weak, reddish brown and occasionally grey mottled, moderately weathered MUDSTONE. (BOLLIN MUDSTONE)			
		pp 50/190mm				End Of Borehole At 2.00 m		
					3.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level		REMARKS No Groundwater Encountered Refused at 2.00mbgl. 	Water Strikes																										
			<table border="1"> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>						Date	Strike	Level	Minutes	Casing	Sealed															
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Scale: 1:20		Daily Log Of Depths																											
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Date	Casing	Water	From	To	Hours																								

		Project Title: Amberley Drive				WS07	
		Project Number: 8538G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 15/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe	
0.20	E				0.10	Turf over dark brown, slightly gravelly, clayey SAND with rootlets. Gravel is subangular, fine to coarse, including sandstone. (TOPSOIL)			
					0.35				Dark grey, slightly sandy, subangular, fine to coarse GRAVEL including ash, clinker and concrete. (MADE GROUND)
0.90	ES	N=9			1.00	Dark brown, slightly gravelly, clayey SAND. Gravel is angular to subangular, fine to coarse, including mudstone, ash, clinker, glass and ceramic. (MADE GROUND)			
					1.10				
					1.75				Firm, orange brown, slightly silty, slightly gravelly, sandy CLAY. Gravel is subangular, fine to coarse, including sandstone, siltstone and mudstone. (GLACIAL TILL)
					2.00				
					3.00	End Of Borehole At 2.00 m			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa - Groundwater Strike - Groundwater Level	REMARKS No Groundwater Encountered Refused at 2.00mbgl. 	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="6">Water Strikes</th> </tr> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="3">Daily Log Of Depths</th> <th colspan="3">Chiselling</th> </tr> <tr> <th>Date</th> <th>Casing</th> <th>Water</th> <th>From</th> <th>To</th> <th>Hours</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>	Water Strikes						Date	Strike	Level	Minutes	Casing	Sealed																									Daily Log Of Depths			Chiselling			Date	Casing	Water	From	To	Hours																		
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		Project Title: Amberley Drive				WS08	
		Project Number: 8538G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 15/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.20	E	N=11			0.30	Turf over dark brown, slightly gravelly, clayey SAND with rootlets. Gravel is subangular, fine to coarse, including sandstone. (TOPSOIL)		
0.40	ES					Soft to firm, orange brown, slightly silty, sandy CLAY with pockets of clayey SAND. (ALLUVIAL DEPOSITS)		
1.00	D				1.00			
					1.45			
		pp 50/235mm			1.60	Stiff, reddish brown, silty CLAY with mudstone lithorelicts. (WEATHERED BOLLIN MUDSTONE)		
						Extremely weak, reddish brown and occasionally grey mottled, moderately weathered MUDSTONE. (BOLLIN MUDSTONE)		
					2.00	End Of Borehole At 2.00 m		
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level		REMARKS Refused at 2.60mbgl. 	Water Strikes <table border="1"> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> <tr> <td>19/03/2019</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	Date	Strike	Level	Minutes	Casing	Sealed	19/03/2019	1																												
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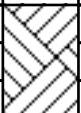
Scale: 1:20

		Project Title: Amberley Drive				WS09	
		Project Number: 8538G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 25/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.20	E				0.40	Turf over dark brown, slightly gravelly, clayey SAND with rootlets. Gravel is subangular, fine to coarse, including sandstone. (TOPSOIL)		
1.20	J	N=13			1.40	Firm, orange brown, slightly silty, sandy CLAY. (WEATHERED BOLLIN MUDSTONE)		
		pp 50/185mm			1.80	Extremely weak, reddish brown and occasionally grey mottled, moderately weathered MUDSTONE. (BOLLIN MUDSTONE)		
					2.00	End Of Borehole At 1.80 m		
					3.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa - Groundwater Strike - Groundwater Level 	REMARKS No Groundwater Encountered Refused at 1.80mbgl. Scale: 1:20	Water Strikes <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table> Daily Log Of Depths <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Date</th> <th>Casing</th> <th>Water</th> <th>From</th> <th>To</th> <th>Hours</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>	Date	Strike	Level	Minutes	Casing	Sealed																			Date	Casing	Water	From	To	Hours												
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		Project Title: Amberley Drive				WS10	
		Project Number: 8538G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 25/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

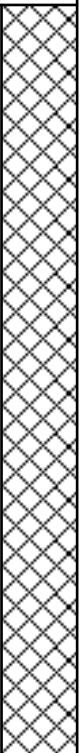
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.30	E	N=4			0.30	Turf over dark brown, slightly gravelly, clayey SAND with rootlets. Gravel is subangular, fine to coarse, including sandstone. (TOPSOIL)		
					0.35	Dark grey, sandy, subangular, fine to coarse GRAVEL including ash and clinker. (MADE GROUND)		
						Firm, orange brown, slightly silty, sandy CLAY. (WEATHERED BOLLIN MUDSTONE)		
1.00	D				1.00			
		pp 50/180mm			1.30	Orange brown, slightly silty, clayey, fine SAND. (WEATHERED BOLLIN MUDSTONE)		
					1.50	Extremely weak, reddish brown and occasionally grey mottled, moderately weathered MUDSTONE. (BOLLIN MUDSTONE)		
					2.00	End Of Borehole At 2.00 m		
					3.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level		REMARKS No Groundwater Encountered Refused at 2.00mbgl. 	Water Strikes					
			Date	Strike	Level	Minutes	Casing	Sealed

		Project Title: Amberley Drive				WS11	
		Project Number: 8538G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 25/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.10	E	N=15			0.25	Turf over dark brown, slightly gravelly, clayey SAND with rootlets. Gravel is subangular, fine to coarse, including sandstone. (TOPSOIL) Firm, orange brown, slightly silty, sandy CLAY. (WEATHERED BOLLIN MUDSTONE)		
					1.00			
					1.30			
1.50	J	pp 50/170mm				Extremely weak, reddish brown and occasionally grey mottled, moderately weathered MUDSTONE. (BOLLIN MUDSTONE)		
					2.00			
					3.00			
						End Of Borehole At 2.00 m		

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa - Groundwater Strike - Groundwater Level 	REMARKS No Groundwater Encountered Refused at 2.00mbgl. Scale: 1:20	Water Strikes <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table> Daily Log Of Depths <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Date</th> <th>Casing</th> <th>Water</th> <th>From</th> <th>To</th> <th>Hours</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>	Date	Strike	Level	Minutes	Casing	Sealed																			Date	Casing	Water	From	To	Hours												
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Date	Casing	Water	From	To	Hours																																							

			Project Title: Amberley Drive				WS12																									
			Project Number: 8538G		Client: Garden City Design & Build Ltd					Sheet 1 Of 1																						
			GL (mAOD):		N Coord: 0		E Coord: 0																									
Date: 25/03/2019			Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB																									
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe																								
0.20	E	N=9			0.20	Turf over dark brown, slightly gravelly, clayey SAND with rootlets. Gravel is subangular, fine to coarse, including sandstone. (TOPSOIL)																										
1.20	J				1.00	Firm, orange brown, slightly silty, sandy CLAY. (WEATHERED BOLLIN MUDSTONE)																										
					1.40	Extremely weak, reddish brown and occasionally grey mottled, moderately weathered MUDSTONE. (BOLLIN MUDSTONE)																										
		pp 50/150mm			2.00	End Of Borehole At 2.00 m																										
					3.00																											
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level			REMARKS No Groundwater Encountered Refused at 2.00mbgl. 			Water Strikes <table border="1"> <thead> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>			Date	Strike	Level	Minutes	Casing	Sealed																		
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Date	Casing	Water	From	To	Hours																											

APPENDIX 03

Geotechnical Testing Results



LABORATORY REPORT



4043

Contract Number: PSL19/2020

Report Date: 26 April 2019
Client's Reference: 8538G
Client Name: WML Consulting
No 8 Oak Green Earl Road
Stanley Green Business Park
Cheadle Hulme
Cheshire
SK8 6QL

For the attention of: Sam Seddon

Contract Title: Amberley Drive
Date Received: 27/3/2019
Date Commenced: 27/3/2019
Date Completed: 26/4/2019

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson
(Director)

A Watkins
(Director)

R Berriman
(Quality Manager)

L Knight
(Senior Technician)


S Eyre
(Senior Technician)

R Cowles
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rgunson@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

4043

PSL
Professional Soils Laboratory

Amberley Drive

Contract No:

PSL19/2020

Client Ref:

8538G

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



4043

PSL
Professional Soils Laboratory

Amberley Drive

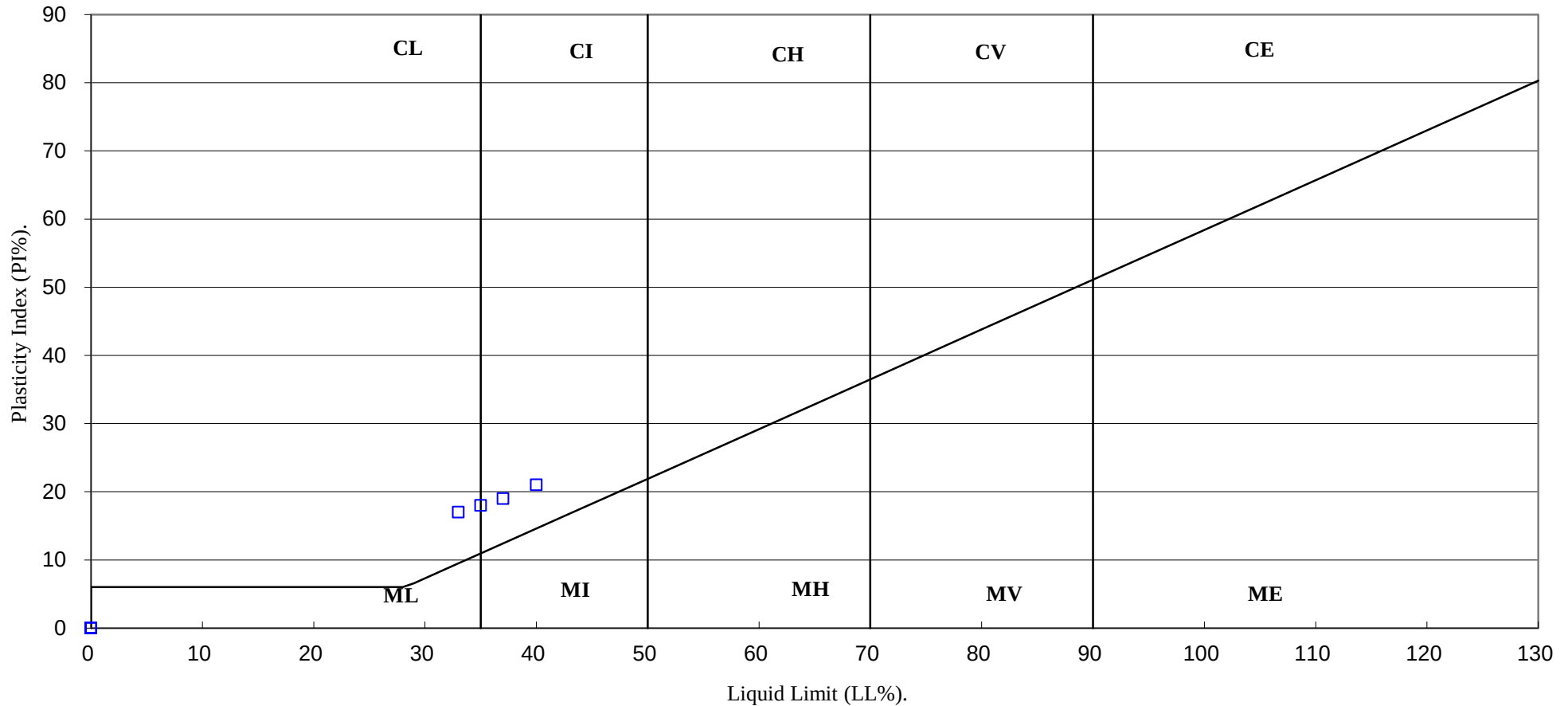
Contract No:

PSL19/2020

Client Ref:

8538G

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



4043

PSL
Professional Soils Laboratory

Amberley Drive

Contract No:

PSL19/2020

Client Ref:

8538G

APPENDIX 04

Chemical Analytical Results



Final Report

Report No.:	19-10360-1		
Initial Date of Issue:	03-Apr-2019		
Client	WML Consulting Ltd		
Client Address:	No. 8 Oak Green Stanley Green Business Park Earl Rd Cheadle SK8 6QL		
Contact(s):	Sam Seddon		
Project	8538G Amberley Drive		
Quotation No.:		Date Received:	26-Mar-2019
Order No.:	8538G	Date Instructed:	26-Mar-2019
No. of Samples:	6		
Turnaround (Wkdays):	7	Results Due:	03-Apr-2019
Date Approved:	03-Apr-2019		
Approved By:			
			
Details:	Robert Monk, Technical Manager		

Results - Soil

Project: 8538G Amberley Drive

Client: WML Consulting Ltd	Chemtest Job No.:				19-10360	19-10360	19-10360	19-10360	19-10360	19-10360
Quotation No.:	Chemtest Sample ID.:				799547	799548	799549	799550	799551	799552
Order No.: 8538G	Client Sample Ref.:				E	J	E	E	J	E
	Client Sample ID.:				12	13	14	15	16	17
	Sample Location:				WS09	WS09	WS10	WS11	WS11	WS12
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.2	1.2	0.3	0.1	1.5	0.1
	Date Sampled:				21-Mar-2019	21-Mar-2019	21-Mar-2019	21-Mar-2019	21-Mar-2019	21-Mar-2019
	Asbestos Lab:				LIVERPOOL		LIVERPOOL	LIVERPOOL		LIVERPOOL
Determinand	Accred.	SOP	Units	LOD						
ACM Type	U	2192		N/A	-		Fibres/Clumps	-		-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected		Crocidolite	No Asbestos Detected		No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-		Stereo Microscopy	-		-
Moisture	N	2030	%	0.020	17	29	13	16	13	15
pH	U	2010		N/A	7.0	7.7	6.2	6.5	8.2	6.4
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40		< 0.40	< 0.40		< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total Sulphur	U	2175	%	0.010	0.025	< 0.010	0.067	0.045	0.022	0.038
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50		< 0.50	< 0.50		< 0.50
Sulphate (Total)	U	2430	mg/kg	100	330		1400	800		540
Arsenic	U	2450	mg/kg	1.0	7.5		16	12		9.7
Cadmium	U	2450	mg/kg	0.10	< 0.10		0.10	0.16		0.16
Copper	U	2450	mg/kg	0.50	14		42	32		21
Mercury	U	2450	mg/kg	0.10	0.12		< 0.10	0.18		0.10
Nickel	U	2450	mg/kg	0.50	24		37	19		21
Lead	U	2450	mg/kg	0.50	30		30	64		38
Selenium	U	2450	mg/kg	0.20	0.22		0.36	0.41		0.26
Vanadium	U	2450	mg/kg	5.0	31		46	25		27
Zinc	U	2450	mg/kg	0.50	47		69	130		53
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50		< 0.50	< 0.50		< 0.50
Organic Matter	U	2625	%	0.40	2.2		9.7	6.7		8.3
Naphthalene	U	2700	mg/kg	0.10	< 0.10		< 0.10	0.70		< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10		< 0.10	0.12		< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10		< 0.10	0.20		< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10		< 0.10	0.25		< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10		< 0.10	2.1		< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10		< 0.10	0.44		< 0.10
Fluoranthene	U	2700	mg/kg	0.10	0.12		0.52	2.3		0.25
Pyrene	U	2700	mg/kg	0.10	0.21		0.44	2.4		0.37
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10		< 0.10	0.48		< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10		< 0.10	0.35		< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10		< 0.10	1.0		< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10		< 0.10	1.1		< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10		< 0.10	0.67		< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10		< 0.10	0.49		< 0.10

Results - Soil

Project: 8538G Amberley Drive

Client: WML Consulting Ltd	Chemtest Job No.:		19-10360	19-10360	19-10360	19-10360	19-10360	19-10360
Quotation No.:	Chemtest Sample ID.:		799547	799548	799549	799550	799551	799552
Order No.: 8538G	Client Sample Ref.:		E	J	E	E	J	E
	Client Sample ID.:		12	13	14	15	16	17
	Sample Location:		WS09	WS09	WS10	WS11	WS11	WS12
	Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):		0.2	1.2	0.3	0.1	1.5	0.1
	Date Sampled:		21-Mar-2019	21-Mar-2019	21-Mar-2019	21-Mar-2019	21-Mar-2019	21-Mar-2019
	Asbestos Lab:		LIVERPOOL		LIVERPOOL	LIVERPOOL		LIVERPOOL
Determinand	Accred.	SOP	Units	LOD				
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10		< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10		0.72	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0		13	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30		< 0.30	< 0.30

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

- U UKAS accredited
- M MCERTS and UKAS accredited
- N Unaccredited
- S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
- SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
- T This analysis has been subcontracted to an unaccredited laboratory
- I/S Insufficient Sample
- U/S Unsuitable Sample
- N/E not evaluated
- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com



Final Report

Report No.: 19-09851-1

Initial Date of Issue: 28-Mar-2019

Client WML Consulting Ltd

Client Address: No. 8 Oak Green
Stanley Green Business Park
Earl Rd
Cheadle
SK8 6QL

Contact(s): Sam Seddon

Project 8538G Amberley Drive

Quotation No.: **Date Received:** 20-Mar-2019

Order No.: 8538G **Date Instructed:** 20-Mar-2019

No. of Samples: 11

Turnaround (Wkdays): 7 **Results Due:** 28-Mar-2019

Date Approved: 28-Mar-2019

Approved By:



Details: Martin Dyer, Laboratory Manager

Project: 8538G Amberley Drive

Client: WML Consulting Ltd	Chemtest Job No.:				19-09851	19-09851	19-09851
Quotation No.:	Chemtest Sample ID.:				796880	796882	796889
Order No.: 8538G	Client Sample Ref.:				ED	ED	ED
	Client Sample ID.:				2	4	11
	Sample Location:				WS01	WS02	WS07
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				0.4	0.7	0.9
	Date Sampled:				15-Mar-2019	15-Mar-2019	15-Mar-2019
Determinand	Accred.	SOP	Units	LOD			
pH	U	1010		N/A	7.7	6.9	7.2
Sulphur	N	1220	mg/l	1.0	< 1.0	6.0	< 1.0
Sulphate	U	1220	mg/l	1.0	< 1.0	18	< 1.0
Hardness	U	1415	mg/l	15	140	49	97
Arsenic (Dissolved)	U	1450	µg/l	1.0	6.9	< 1.0	19
Boron (Dissolved)	U	1450	µg/l	20	< 20	< 20	20
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080
Copper (Dissolved)	U	1450	µg/l	1.0	5.1	2.9	8.7
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	2.7	1.7	1.6
Lead (Dissolved)	U	1450	µg/l	1.0	7.4	1.3	12
Selenium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	4.6	< 1.0	10
Zinc (Dissolved)	U	1450	µg/l	1.0	12	2.1	6.8
Chromium (Hexavalent)	U	1490	µg/l	20	< 20	< 20	< 20
Naphthalene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Chrysene	N	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	1700	µg/l	2.0	< 2.0	< 2.0	< 2.0
Total Phenols	U	1920	mg/l	0.030	< 0.030	< 0.030	< 0.030

Results - Soil

Project: 8538G Amberley Drive

Client: WML Consulting Ltd	Chemtest Job No.:				19-09851	19-09851	19-09851	19-09851	19-09851	19-09851	19-09851	19-09851
Quotation No.:	Chemtest Sample ID.:				796879	796881	796883	796884	796885	796886	796887	796888
Order No.: 8538G	Client Sample Ref.:				E	E	J	E	E	J	E	E
	Client Sample ID.:				1	3	5	6	7	8	9	10
	Sample Location:				WS01	WS02	WS02	WS03	WS04	WS04	WS06	WS07
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.2	0.3	1.5	0.1	0.3	1.5	0.1	0.2
	Date Sampled:				15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019
	Asbestos Lab:				COVENTRY	COVENTRY		COVENTRY	COVENTRY		COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD								
ACM Type	U	2192		N/A	-	-		-	-		-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected		No Asbestos Detected	No Asbestos Detected		No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-		-	-		-	-
Moisture	N	2030	%	0.020	19	19	22	19	28	16	19	20
pH	U	2010		N/A	7.1	7.0	8.1	6.4	7.3	7.6	5.0	7.8
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.40	0.84		0.54	0.59		0.64	0.41
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.069
Total Sulphur	U	2175	%	0.010	0.055	0.073	0.018	0.16	0.10	0.011	0.067	0.20
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	3.8		< 0.50	0.70		0.70	< 0.50
Sulphate (Total)	U	2430	mg/kg	100	650	1000		830	1900		950	2500
Arsenic	U	2450	mg/kg	1.0	21	29		27	34		17	27
Cadmium	U	2450	mg/kg	0.10	0.31	0.53		0.24	0.83		0.14	0.18
Copper	U	2450	mg/kg	0.50	50	80		60	110		31	73
Mercury	U	2450	mg/kg	0.10	0.25	3.8		0.49	0.62		0.13	0.13
Nickel	U	2450	mg/kg	0.50	40	30		37	41		17	71
Lead	U	2450	mg/kg	0.50	110	400		120	270		64	51
Selenium	U	2450	mg/kg	0.20	0.36	0.59		0.48	0.59		0.53	0.52
Vanadium	U	2450	mg/kg	5.0	36	36		39	43		28	47
Zinc	U	2450	mg/kg	0.50	130	180		92	630		64	74
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50		< 0.50	< 0.50		< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	7.6	8.3		17	16		8.1	29
Naphthalene	U	2700	mg/kg	0.10	< 0.10	0.13		0.15	< 0.10		< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10		0.16	< 0.10		< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	0.22		0.14	< 0.10		< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	0.19		0.24	< 0.10		< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	0.56	1.8		0.88	0.70		0.20	0.66
Anthracene	U	2700	mg/kg	0.10	< 0.10	0.32		0.14	< 0.10		< 0.10	0.23
Fluoranthene	U	2700	mg/kg	0.10	0.55	2.1		0.94	0.74		0.25	1.7
Pyrene	U	2700	mg/kg	0.10	0.63	2.4		1.1	0.82		0.29	1.9
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	1.1		0.27	< 0.10		< 0.10	1.2
Chrysene	U	2700	mg/kg	0.10	< 0.10	1.4		0.22	< 0.10		< 0.10	1.4
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	1.2		0.40	< 0.10		< 0.10	1.5
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	1.0		0.18	< 0.10		< 0.10	1.1
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	1.1		0.31	< 0.10		< 0.10	1.4
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	0.70		0.27	< 0.10		< 0.10	1.1
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	0.32		0.17	< 0.10		< 0.10	0.46

Results - Soil

Project: 8538G Amberley Drive

Client: WML Consulting Ltd	Chemtest Job No.:					19-09851	19-09851	19-09851	19-09851	19-09851	19-09851	19-09851	19-09851	19-09851
Quotation No.:	Chemtest Sample ID.:					796879	796881	796883	796884	796885	796886	796887	796888	796888
Order No.: 8538G	Client Sample Ref.:					E	E	J	E	E	J	E	E	E
	Client Sample ID.:					1	3	5	6	7	8	9	10	10
	Sample Location:					WS01	WS02	WS02	WS03	WS04	WS04	WS06	WS07	WS07
	Sample Type:					SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):					0.2	0.3	1.5	0.1	0.3	1.5	0.1	0.2	0.2
	Date Sampled:					15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019	15-Mar-2019
	Asbestos Lab:					COVENTRY	COVENTRY		COVENTRY	COVENTRY		COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD										
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	0.80		0.24	< 0.10		< 0.10	0.94		
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	15		5.8	2.3		< 2.0	14		
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30		< 0.30	< 0.30		< 0.30	< 0.30		

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1490	Hexavalent Chromium in Waters	Chromium [VI]	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
1700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)

SOP	Title	Parameters included	Method summary
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and Trimethylphenols Note: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

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All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

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- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

APPENDIX 05

Gas Monitoring Results

Gas & Groundwater Monitoring Record Sheet



Project Name:- Amberley Drive
Project No:- 8538G
Client:- Garden City Design & Build

Date:- 03/04/2019
Start Time:- 10:05
End Time:- 11:00
Ground Conditions:- Damp
Weather Conditions:- Overcast

Atmospheric Pressure
Start:- 993mb
End:- 994mb
Trend:- Falling

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4		CO2		Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak	GSV l/hr	Peak	GSV l/hr						
WS01	<0.1	<0.1	0	0.0	0.0000	0.5	0.0005	19.8	0	0	0.000	1.30	2.70
WS03	<0.1	<0.1	0	0.0	0.0000	2.8	0.0028	14.7	0	0	0.000	1.70	1.80
WS04	<0.1	<0.1	0	0.0	0.0000	2.4	0.0024	17.4	0	0	0.000	1.80	2.50
WS09	<0.1	<0.1	0	0.0	0.0000	0.4	0.0004	19.8	0	0	0.000	1.13	2.00
WS10	<0.1	<0.1	0	0.0	0.0000	1.0	0.0010	19.3	0	0	0.000	1.36	2.10
WS11	<0.1	<0.1	0	0.0	0.0000	0.9	0.0009	19.3	0	0	0.000	1.58	2.10

Additional Comments

Gas & Groundwater Monitoring Record Sheet



Project Name:- Amberley Drive
Project No:- 8538G
Client:- Garden City Design & Build

Date:- 09/04/2019
Start Time:- 08:30
End Time:- 09:15
Ground Conditions:- Damp
Weather Conditions:- Overcast

Atmospheric Pressure
Start:- 1010mb
End:- 1010mb
Trend:- Rising

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4		CO2		Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak	GSV l/hr	Peak	GSV l/hr						
WS01	<0.1	<0.1	0	0.0	0.0000	6.3	0.0063	9.9	0	0	0.000	1.37	2.70
WS03	<0.1	<0.1	0	0.0	0.0000	3.4	0.0034	13.6	0	0	0.000	dry	1.80
WS04	<0.1	<0.1	0	0.0	0.0000	1.4	0.0014	19.3	0	0	0.000	2.00	2.50
WS09	<0.1	<0.1	0	0.0	0.0000	0.3	0.0003	20.3	0	0	0.000	1.35	2.00
WS10	<0.1	<0.1	0	0.0	0.0000	1.2	0.0012	19.4	0	0	0.000	1.45	2.10
WS11	<0.1	<0.1	0	0.0	0.0000	1.1	0.0011	19.4	0	0	0.000	1.60	2.10

Additional Comments

Gas & Groundwater Monitoring Record Sheet



Project Name:- Amberley Drive
Project No:- 8538G
Client:- Garden City Design & Build

Date:- 08/05/2019
Start Time:- 07:40
End Time:- 09:40
Ground Conditions:- Damp
Weather Conditions:- Overcast

Atmospheric Pressure
Start:- 991mb
End:- 991mb
Trend:- Steady

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4		CO2		Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak	GSV l/hr	Peak	GSV l/hr						
WS01	-	-	-	-	-	-	-	-	-	-	-	-	-
WS03	-	-	-	-	-	-	-	-	-	-	-	-	-
WS04	-	-	-	-	-	-	-	-	-	-	-	-	-
WS09	<0.1	<0.1	0	0.0	0.0000	1.1	0.0011	19.5	0	0	0.000	1.50	2.00
WS10	<0.1	<0.1	0	0.0	0.0000	1.4	0.0014	19.3	0	0	0.000	1.54	2.10
WS11	<0.1	<0.1	0	0.0	0.0000	1.2	0.0012	19.3	0	0	0.000	1.70	2.10

Additional Comments

WS01, WS03 and WS04 secured from access

Gas & Groundwater Monitoring Record Sheet



Project Name:- Amberley Drive
Project No:- 8538G
Client:- Garden City Design & Build

Date:- 22/05/2019
Start Time:- 07:45
End Time:- 08:30
Ground Conditions:- Damp
Weather Conditions:- Drizzle

Atmospheric Pressure
Start:- 1014mb
End:- 1013mb
Trend:- Falling

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4		CO2		Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak	GSV l/hr	Peak	GSV l/hr						
WS01	<0.1	<0.1	0	0.0	0.0000	6.2	0.0062	15.9	0	0	0.000	1.80	2.72
WS03	<0.1	<0.1	0	0.0	0.0000	6.0	0.0060	15.7	0	0	0.000	Dry	1.80
WS04	-	-	-	-	-	-	-	-	-	-	-	-	-
WS09	<0.1	<0.1	0	0.0	0.0000	1.4	0.0014	19.8	0	0	0.000	1.60	2.00
WS10	<0.1	<0.1	0	0.0	0.0000	1.5	0.0015	19.6	0	0	0.000	1.60	2.10
WS11	<0.1	<0.1	0	0.0	0.0000	1.8	0.0018	19.5	0	0	0.000	1.82	2.10

Additional Comments

WS04 overgrown.

Gas & Groundwater Monitoring Record Sheet



Project Name:- Amberley Drive
Project No:- 8538G
Client:- Garden City Design & Build

Date:- 17/06/2019
Start Time:- 10:30
End Time:- 11:15
Ground Conditions:- Wet
Weather Conditions:- Drizzle

Atmospheric Pressure
Start:- 1010mb
End:- 1009mb
Trend:- Rising

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4		CO2		Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak	GSV l/hr	Peak	GSV l/hr						
WS01	<0.1	<0.1	0	0.0	0.0000	4.9	0.0049	14.2	0	0	0.000	1.70	2.66
WS03	<0.1	<0.1	0	0.0	0.0000	4.2	0.0042	13.8	0	0	0.000	1.55	1.77
WS04	-	-	-	-	-	-	-	-	-	-	-	-	-
WS09	<0.1	<0.1	0	0.0	0.0000	1.4	0.0014	20.5	0	0	0.000	1.06	2.00
WS10	<0.1	<0.1	0	0.0	0.0000	1.4	0.0014	19.7	0	0	0.000	1.10	2.00
WS11	<0.1	<0.1	0	0.0	0.0000	1.3	0.0013	19.5	0	0	0.000	-	-

Additional Comments

WS04 Overgrown

Gas & Groundwater Monitoring Record Sheet



Project Name:- Amberley Drive
Project No:- 8538G
Client:- Garden City Design & Build

Date:- 27/06/2019
Start Time:- 10:00
End Time:- 11:00
Ground Conditions:- Damp
Weather Conditions:- Overcast

Atmospheric Pressure
Start:- 1026mb
End:- 1026mb
Trend:- Rising

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4		CO2		Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak	GSV l/hr	Peak	GSV l/hr						
WS01	<0.1	<0.1	0	0.0	0.0000	6.5	0.0065	10.1	0	0	0.000	1.67	2.67
WS03	<0.1	<0.1	0	0.0	0.0000	6.3	0.0063	9.5	0	0	0.000	1.80	1.80
WS04	-	-	-	-	-	-	-	-	-	-	-	-	-
WS09	<0.1	<0.1	0	0.0	0.0000	1.9	0.0019	16.1	0	0	0.000	1.35	2.00
WS10	<0.1	<0.1	0	0.0	0.0000	2.3	0.0023	18.0	0	0	0.000	1.50	2.00
WS11	<0.1	<0.1	0	0.0	0.0000	1.4	0.0014	19.3	0	0	0.0	1.70	2.00

Additional Comments

WS4 could not be located in undergrowth

TEST DATE AND CONDITIONS			
Date	17/08/18		
Atmospheric Pressure	1001	mB	
Ambient Temperature	21.7	°C	
EnviroNics Serial No.	5089		

**GFM436 Final Inspection & Calibration
Check Certificate**

GAS DATA LTD

Unit 4, Fairfield Court

Seven Stars Estate

Wheler Rd

Coventry

CV3 4LJ

Tel 02476303311

Fax 02476307711



Customer	WML Consulting Ltd
Certificate Number	120377
Order Number	320675

Serial Number	12969
Software Version	G436-00.0027/0010

Recalibration DUE Date
17/08/19

Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	500	Accept > 200 cc/min	Pump Flow @ -200mB	300	Accept > 200 cc/min
Clock Set / Running	✓		Labels Fitted	✓	

Gas Checks						
Sensor	CH ₄		CO ₂		O ₂	
	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %
	Readings %		Readings %		Readings %	
	60	60	40	40	20.9	20.9
	Accept ±3.0		Accept ±3.0		Accept ±0.5	
	5	5	5	5	6	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N ₂	0	0	0	0	0	0
	Accept ±0.0		Accept ±0.0		Accept ±0.1	

Optional Gas Checks						
Applied Gas & Range		Concentration Tested @ (ppm)	Instrument Readings (ppm)			
Gas Type	Range (ppm)		Zero Reading		Instrument Gas Reading	
H ₂ S	5000	1500	0	Accept ±0.0	1500	Accept ±5.0
CO	2000	1000	0	Accept ±0.0	1000	Accept ±5.0
Hexane	2.0%	2.0%	0	Accept ±0.0	1.99	Accept ±10.0

Cross Gas Effects									
Applied Gas (ppm)		Instrument Readings (ppm)							
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	CO	Toxic 3:	HEX		
H2S	1500	1500		0		0			
CO	1000	80		1000		0			
Hexane	2.0%	0		0		1.99			

Pressure Checks			
Atmospheric Pressure [AP] (mB)			
Current Atmospheric Pressure (mB)		Instrument Atmospheric Pressure Reading (mB)	
AP Open Ports		1001	Accept ± 2.0
AP Port (Internal)	+800 mB	800	Accept ± 5.0
	+1200 mB	1200	Accept ± 5.0

Flow Checks					
Borehole Flow			Differential Pressure		
Applied Reading (l/h)	Instrument Reading (l/h)		Applied Pressure (Pa)	Instrument Reading (Pa)	
-30	-30.1	Accept ± 3.0	-545	-552	Accept ± 50
-3	-3	Accept ± 1.0	-22	-22	Accept ± 6.0
0	0	Accept ± 0.0	0	0	Accept ± 0.5
3	3	Accept ± 0.5	16	16	Accept ± 3.0
30	30	Accept ± 3.0	384	384	Accept ± 50
60	60	Accept ± 6.0	1185	1181	Accept ± 130
90	90.5	Accept ± 9.0	2333	>>>>	Accept ± 250

Temperature Checks		
Calibration Temperature	Instrument Temperature Reading $^{\circ}\text{C}$	
Applied Temperature $^{\circ}\text{C}$		
-10	-10	Accept ± 2.0
0	0	Accept ± 1.0
30	30	Accept ± 1.0
60	60	Accept ± 1.0
100	100	Accept ± 1.0

Technician:
Jack Rutland

Date Tested:
20/08/18

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated. The results displayed on the instrument at each stage are recorded above.

TEST DATE AND CONDITIONS			
Date	14/08/19		
Atmospheric Pressure	993	mB	
Ambient Temperature	21.9	°C	
EnviroNics Serial No.	5089		

**GFM436 Final Inspection & Calibration
Check Certificate**

GAS DATA LTD

Unit 4, Fairfield Court

Seven Stars Estate

Wheler Rd

Coventry

CV3 4LJ

Tel 02476303311

Fax 02476307711



Customer	WML Consulting Ltd
Certificate Number	121220
Order Number	323564

Serial Number	12969
Software Version	G436-00.0027/0010

Recalibration DUE Date
14/08/20

Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	500	Accept > 200 cc/min	Pump Flow @ -200mB	300	Accept > 200 cc/min
Clock Set / Running	✓		Labels Fitted	✓	

Gas Checks						
Sensor	CH ₄		CO ₂		O ₂	
	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %
	Readings %		Readings %		Readings %	
	60	60	40	40	20.9	20.9
	Accept ±3.0		Accept ±3.0		Accept ±0.5	
Zero Reading 100% N ₂	5	5	5	5	6	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N ₂	0	0	0	0	0	0
	Accept ±0.0		Accept ±0.0		Accept ±0.1	

Optional Gas Checks						
Applied Gas & Range		Concentration Tested @ (ppm)	Instrument Readings (ppm)			
Gas Type	Range (ppm)		Zero Reading		Instrument Gas Reading	
H ₂ S	5000	1500	0	Accept ±0.0	1500	Accept ±5.0
CO	2000	1000	0	Accept ±0.0	1000	Accept ±5.0
Hexane	2.0%	2.0%	0	Accept ±0.0	1.99	Accept ±10.0

Cross Gas Effects									
Applied Gas (ppm)		Instrument Readings (ppm)							
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	CO	Toxic 3:	HEX		
H2S	1500	1500		0		0			
CO	1000	40		1000		0			
Hexane	2.0%	0		0		1.99			

Pressure Checks			
Atmospheric Pressure [AP] (mB)			
Current Atmospheric Pressure (mB)		Instrument Atmospheric Pressure Reading (mB)	
AP Open Ports		993	Accept ± 2.0
AP Port (Internal)	+800 mB	800	Accept ± 5.0
	+1200 mB	1200	Accept ± 5.0

Flow Checks					
Borehole Flow			Differential Pressure		
Applied Reading (l/h)	Instrument Reading (l/h)		Applied Pressure (Pa)	Instrument Reading (Pa)	
-30	-30.3	Accept ± 3.0	-556	-570	Accept ± 50
-3	-3	Accept ± 1.0	-23	-22	Accept ± 6.0
0	0	Accept ± 0.0	0	0	Accept ± 0.5
3	3	Accept ± 0.5	17	17	Accept ± 3.0
30	30	Accept ± 3.0	385	384	Accept ± 50
60	60	Accept ± 6.0	1192	1193	Accept ± 130
90	90.4	Accept ± 9.0	2362	>>>>	Accept ± 250

Temperature Checks		
Calibration Temperature	Instrument Temperature Reading °C	
Applied Temperature °C		
-10	-10	Accept ± 2.0
0	0	Accept ± 1.0
30	30	Accept ± 1.0
60	60	Accept ± 1.0
100	100	Accept ± 1.0

Technician:
<i>Jack Rutland</i>

Date Tested:
15/08/19

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated. The results displayed on the instrument at each stage are recorded above.

APPENDIX 06

Site Specific Acceptance Criteria

Site Specific Assessment Criteria for Residential (with homegrown produce) assuming a 2.5% SOM for Hydrocarbons

Contaminant	Assessment Criteria for Residential (mg/kg)
Metals	
Arsenic	37
Boron	290
Cadmium	26
Chromium III	910
Chromium VI	6
Copper	2,400
Lead*	200
Mercury	1.2
Nickel	130
Selenium	250
Vanadium	410
Zinc	3,700
Non – Metals	
Phenol	200
Polyaromatic Hydrocarbons (PAH)	
Benz[a]anthracene	11
Benzo[a]pyrene	2.7
Benzo[b]fluoranthene	3.3
Benzo[ghi]perylene	340
Benzo[k]fluoranthene	93
Chrysene	22
Dibenz[ah]anthracene	0.28
Fluoranthene	560
Indeno[123-cd]pyrene	26
Naphthalene	5.6
Pyrene	1,200

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* Where not included in the S4UL's criteria for a limited number of contaminants, namely lead, have been derived by DEFRA in their document entitled SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, April 2014.

Contaminant	Criteria for Residential End Use (mg/kg)
Volatile Organic Compounds (VOCs)	
Benzene	0.17
Ethylbenzene	110
Toluene	290
Xylene	130
1,2-Dichloroethane	0.011
1,1,1-Trichloroethane	18
Tetrachloroethane	3.4
Tetrachloroethene (PCE)	0.39
Tetrachloromethane	0.056
Trichloroethene (TCE)	0.034
Trichloromethane	1.7
Vinyl Chloride	0.00087
Semi-Volatile Organic Compounds (SVOCs)	
1,2-Dichlorobenzene	55
1,4-Dichlorobenzene	150 ^f
1,2,4-Trichlorobenzene	6.4
Hexachlorobenzene	3.3 (0.5) ^{vap}
Total Petroleum Hydrocarbons (TPH)	
Aliphatic C5-6	78
Aliphatic C6-8	230
Aliphatic C8-10	65
Aliphatic C10-12	330(118) ^{vap}
Aliphatic C12-16	2,400(59) ^{sol}
Aliphatic C16-35	92,000(21) ^{f, sol}
Aliphatic C35 - 44	92,000(21) ^{f, sol}
Aromatic C5 – 7 (benzene)	140
Aromatic C7 – 8 (toluene)	290
Aromatic C8-10	83
Aromatic C10-12	180
Aromatic C12-16	330
Aromatic C16-21	540 ^f
Aromatic C21-35	1,500 ^f
Aromatic C35 - 44	1,500 ^f

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* Where not included in the S4UL's criteria for a limited number of contaminants, namely lead, have been derived by DEFRA in their document entitled SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, April 2014.

The GAC's for the assessment of potential groundwater contamination have been derived from very conservative guidelines protective of drinking water and environmental quality, namely:

- UK Drinking Water Standards (DWS) as defined by The Water Supply (Water Quality) Regulations, 2016;
- UK Environmental Quality Standards (EQS) for Freshwater, based on a Hardness of 0-100mg/l (soft), 2000;
- Petroleum Products in Drinking-water, Background document for development of WHO Guidelines for Drinking-water Quality, 2011.

Table 1: Inorganic Tier 1 Water Environment Screening Criteria

Contaminant	Units	Hardness Banding (CaCO ₃ mg/l)	EQS /WFD (Freshwater)	UK DWS
Arsenic	µg/l	-	50	10
Ammonia	mg/l	-	0.2	0.5
Boron	µg/l	-	2000	1000
Cadmium	µg/l	-	5	5
Chromium	µg/l	0-50	2	50
		50-100	10	
		100-150	10	
		150-200	20	
		200-250	20	
Copper	µg/l	0-10	0.5	2000
		10-50	0.5	
		50-200	3	
		200-250	8	
		>250	12	
Cyanide (Free)	µg/l	-	1	-
Cyanide	-	-	-	50
Iron	µg/l	-	1000	200
Lead	µg/l	0-50	4	10
		50-150	10	
		150-250	20	
		>250	20	
Mercury	µg/l	-	1	1
Nickel	µg/l	0-50	8	20
		50-100	20	
		100-150	20	
		150-250	40	
		>250	40	
Selenium	µg/l	-	-	10
Sulphate (SO ₄)	mg/l	-	400	250
Zinc	µg/l	0-50	8	5000
		50-150	15	
		150-250	50	
		>250	50	
pH	-	-	6-9	-

Table 2: Organic Tier 1 Water Environment Screening Criteria

Contaminant	Units	UK DWS	WHO
PAHs - The sum of • Benzo(b)fluoranthene, • Benzo(ghi)perylene, • Benzo(k)fluoranthene, • indeno(1,2,3-c,d)pyrene)	µg/l	0.1	-
Phenol (total)	µg/l	0.5	-
MTBE	µg/l	-	15
Aliphatic C5-C6	µg/l	-	15,000
Aliphatic C6-C8	µg/l	-	15,000
Aliphatic C8-C10	µg/l	-	300
Aliphatic C10-C12	µg/l	-	300
Aliphatic C12-C16	µg/l	-	300
Aliphatic C16-21	µg/l	-	(300) *
Aliphatic C21-35	µg/l	-	(300)*
Aromatic C6-C7	µg/l	1 (benzene)	10 (benzene)
Aromatic C7-C8	µg/l	-	700 (toluene)
Aromatic C8-C10	µg/l	-	300 (ethylbenzene)
Aromatic C10-12	µg/l	-	100
Aromatic C12-C16	µg/l	-	100
Aromatic C16-C21	µg/l	-	90
Aromatic C21-C35	µg/l	-	90