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Phase 2 – Intrusive Ground Investigation Report

Proposed Residential Development,

Sproatley Road,

Preston,

East Yorkshire.

11th January 2021

T. L. P. Ground Investigations.

Proposed Residential Development, Sproatley Road, Preston, East Yorkshire

Appendix in Order

Site and Borehole Location Plans
Remediation Plan
Windowless Sampling Borehole Logs
CBR Test Sheets
Percolation Trials / Soakaways
Plasticity Testing
Soil & Groundwater Contamination Test Results & WIR Test Results
Statistical Analysis
Cover System Calculation
BS3882 Topsoil Analysis

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Phase 2 – Intrusive Ground Investigation Report

Site: Proposed Residential Development, Sproatley Road, Preston, East Yorkshire.

Client: Ward Homes Yorkshire.

Engineers: Charles Ward.

Date: 11th January 2021.

Executive Summary

Introduction	TLP Ground Investigations Ltd. were instructed by Ward Homes Yorkshire to undertake a Phase II Intrusive Survey in connection with a Proposed Residential Development, Sproatley Road, Preston, East Yorkshire.
Previous Desk Study - 26th November 2020	A Phase I Desk Study undertaken by TLP on 26th November 2020 identified limited pollution linkages at the site associated with its historical use and from potential contamination that may have migrated onto the site from off-site sources. Potential contamination perceived to be associated with these activities included metals, semi-metals, poly-aromatic hydrocarbons (PAH's), Total Petroleum Hydrocarbons (TPH), asbestos and harmful ground vapours.
Intrusive Survey	In accordance with the recommendations set out in the Desk Study, TLP carried out a Phase II Intrusive Investigation. The survey included the sinking of sampling boreholes followed up by chemical analysis of representative soil and groundwater samples.
Contamination Summary and Remediation.	**Soil** One of the twelve samples submitted for testing recorded slightly a elevated concentration of 'Lead' compared with current guideline values for a 'residential development with the consumption of home grown produce'. The localised areas affected by the elevated Lead contamination are considered to be the proposed garden areas of Plots 11 and 12. These garden areas will require remediation to limit the risk to acceptable levels. It has been determined that the maximum thickness of cover required to mitigate the risk from the recorded Lead contamination should be 252mm (see enclosed spread sheet in appendix). Following remediation and subsequent validation the risk class attributed to future site users would be Low. Areas of the site covered by foundation concrete and permanent hard surfacing will not require remediation as an effective barrier will exist between potentially contaminated soils and the end users of the site. Any temporary minor risk to ground / construction workers could be mitigated by the use of appropriate PPE and dust suppression measures. **Cover System Plot 11 & 12** As the severity of the identified Lead contamination of the near surface soils in the vicinity of BH1 is slight to moderate, rather than severe, the most feasible remedial strategy would be the provision of a simple cover system of appropriate thickness over the intended garden areas and also any exposed areas of soft landscaping **in this part of the site only.** Using the contamination test data obtained from BH1 and the procedures outlined in the BRE Publication 'Cover Systems For Land Regeneration' March 2004, it has been determined that **the thickness of cover required to mitigate the risk from the recorded Lead contamination should**

be 252mm (see enclosed spread sheet). In order to avoid removal from site, any soils deemed to be contaminated by Lead could potentially be reused beneath any less sensitive areas of the proposed development, i.e. beneath areas of permanent hard surfacing. The soil cover should also be of sufficient nutrient status to provide an effective media for healthy plant growth.

The above calculation assumes that the level of contamination in the imported cover materials is well within acceptable guideline values. The BRE publication does not specify materials, which should be used for a cover system other than it should be of 'good quality' and should incorporate a topsoil layer, ideally at least 150mm in thickness or 30% of the cover thickness, whichever is the greater. Reference should be made to Specification for Topsoil BS 3882 2007. Natural soil including sands and gravels and low plasticity clays or mixtures of various soils should be acceptable, provided it has been certified 'clean' at source and has the appropriate documentation.

As the covering of topsoil in other parts of the site (i.e. areas outside that demarked in remediation plan)**, was found to be within contamination guideline values for residential garden use, the use of 'site won' topsoil from these areas would be considered acceptable.** The provision of a layer of granular material within / at the base of the cover system would serve to act as a capillary break. The existing ground should be suitably compacted prior to placement of the cover system (as set out in CIRIA SP 105). This will inhibit root penetration, infiltration, burrowing animals and instability but should not be compacted to such an extent that it will induce water logging.

Where soil remediation has been undertaken, a validation report may be required by the regulatory authorities to verify that the works have been completed to a satisfactory specification.

Controlled Waters

Although a slightly elevated concentration of Lead was identified within the near surface deposits of made ground at the location of BH1, once this localised area has been suitably remediated the potential for the generation of contaminated leachate should be reduced. The recent tests performed on samples of the groundwater recorded concentrations of Lead below the limit of analytical detection. The development will involve covering significant parts of the site with permanent hard surfacing and structures, which will reduce the amount of rainwater entering the near surface deposits and hence reduce the potential for the generation of potentially contaminated leachate. The site is not situated within 500m of a groundwater SPZ. The nearest current abstraction point is situated 433m southwest of the site where water is abstracted from a borehole point source for general washing / process washing. The chalk aquifer which is present at depth beneath the site will be considered a highly sensitive receptor and should be afforded a high level of protection. The superficial soils have been designated as a Secondary A Aquifer in terms of water supply and would also be considered sensitive.

Land Gasses

The Phase 1 Desk Study Report has not identified any significant areas of in-filled ground or historical landfill sites within 250m of the study site that could be considered credible sources of harmful ground gas generation such as methane and carbon dioxide.

The site is not located in a potential Radon Affected Area as less than 1% of homes, are anticipated to be above the Action Level for homes i.e 200Bqm-). The Groundsure Report indicates that as described in the British Research Establishment publication BR211, in this category, no radon protective measures are necessary for new properties or extensions to existing ones.

Potable Water Supply Pipe Selection

As a localised very slightly elevated concentration of Lead has been identified in the near surface soils in one area of the site, the local Water Authority will need to be contacted to ascertain the most appropriate materials for use in potable water supply pipes.
It should be noted that BH1 (where slightly elevated Lead was encountered) is located in the south eastern corner of the site and away from any proposed water main runs from Sproatly Road.

Reference should be made to UKWIR Publication 2010. Provided the correct procedures are

	implemented to protect water pipes from the identified contamination, then the risk class attributed to future site users would be Low. Comparing the results of a WIR suite of tests from two representative soil samples with available pipe selection tables would suggest that PE pipe could be adopted for potable water supply. However, the soil sample submitted for WIR testing was located outside the area where slight Lead contamination was identified and this should be considered when determining the most suitable material for potable water supply pipes. Provided the correct procedures are implemented to protect water pipes from the observed contamination, then the risk class attributed to future site users would be - Low.
Geotechnical Comments	**Ground Conditions** The recent borings have revealed that the site is overlain by a covering of topsoil and disturbed ground extending to depths of between 0.45m and 0.90m beneath the surface. Over the majority of the site, the underlying natural superficial deposits are initially represented by a sequence of Glacio-fluvial Deposits represented by 'loose' to medium dense silty, fine sand. At depths of between 3.20m to 3.25m beneath the surface, these granular deposits overlie 'soft', brown, laminated, silty clay or 'soft to firm', brown, silty, slightly sandy Boulder Clay. In the north part of the site, the sandy Glacio-fluvial Deposits were found to be largely absent. Here the deposits of topsoil and disturbed ground were underlain by weathered deposits of Glacial Till, predominantly represented by Boulder Clay. This initially comprised deposits of 'firm' mid brown, silty, very sandy clay / clayey sand containing occasional fine assorted gravel. These deposits quickly graded into 'firm' becoming 'stiff', brown, mottled grey, silty, slightly sandy Boulder Clay containing occasional fine fragments of chalk coal and other assorted stones. Once penetrated, the deposits of Boulder Clay subsequently extended to the full depth of borehole penetration. Deposits of Boulder Clay were also encountered in BH4 underlying the Glacio-fluvial sandy deposits at a depth of 3.25m beneath the surface. **Groundwater** 'Perched' groundwater seepages were experienced whilst penetrating the granular (sandy) Glacio-fluvial deposits at depths of between 1.70m and 2.30m beneath the surface. On completion, groundwater levels in the open borings were measured at depths of between 1.19m and 2.15m beneath the surface. In the northeast corner of the site where the deposits of glacial Boulder Clay were encountered, surface water seepages were observed towards the base of the topsoil or superficial weathered sandy deposits at the interface with the more impermeable deposits of clay beneath. These near surface infiltrations although relatively slow, did begin to drain into and accumulate in the open borings, with levels rising to depths between 0.30m and 1.30m beneath the surface. If these water seepages within the upper topsoil / disturbed ground in the northern part of the site were able to be sealed off, it is likely the boulder clay itself would have remained dry. **Foundations & Excavation** The natural deposits of 'loose' to 'medium dense' silty, fine sand could provide a satisfactory foundation bearing stratum for conventional shallow spread foundations, provided the magnitude of loading does not risk bearing capacity failure and/or excessive settlement. The depth of the foundation excavations will also need to take into consideration the prevailing groundwater conditions existing beneath the various parts of the site. As a preliminary guide to design it has been estimated that for a conventional strip foundation say 600mm wide constructed on undisturbed deposits of 'loose' to 'medium dense', silty sand above the water table (at depths of around 750mm to 900mm b.g.l.), the net allowable foundation bearing pressure would be of the order 100kN/m^2. At this loading, long term settlement should be limited to within 25mm. If looser deposits are identified in the base of foundation excavations, then it would be prudent to consider increasing the width of the foundations to around 800mm to 900mm to help distribute the foundation loading within the weaker materials. If, however, excavations encounter groundwater ingress at very shallow depth, which is a possibility in some areas of the site, then this may require the provision of trench supports and dewatering facilities to enable construction can proceed under optimum conditions. Alternatively it may be more practical to adopt a surface raft solution where these conditions are encountered.

In the northern corner of the site the Glacio-fluvial deposits of silty sand were absent and the deposits of topsoil and slightly disturbed ground were underlain by deposits of silty, initially very sandy Boulder Clay. These deposits were generally found to be at least 'firm' in consistency, but became stiffer with increasing depth as the deposits became less weathered. Conventional strip foundations which are constructed within Boulder clay with a consistency which is at least 'firm' should have a safe foundation bearing capacity estimated to be in the order of 120kN/m^2. Care should also be exercised whilst forming the foundation excavations in this part of the site particularly if undertaken during periods of wet weather. The presence of impermeable Boulder clay at shallow depth could encourage the accumulation of surface water which could potentially enter and pour from the near surface into open excavations. This could result in deterioration of the bearing stratum and should be avoided. Additional boreholes (i.e. Boreholes BH9 – BH14) in the northern part of the site were located in an attempt to define as far as possible where the deposits of sand and gravel are essentially absent and the Boulder Clay is present close to the surface. The available borehole information appears to indicate that the proposed dwellings on Plots 23 and 24 are likely to be underlain by deposits of Boulder Clay close to the surface. It is also considered possible that Boulder Clay could be present at shallow depth beneath the northern corner of Plot 22.

Plasticity of Clay & Deeper / Specialised Foundations

Atterberg limit determinations have revealed that the deposits of Glacial Boulder Clay are of medium shrinkage / swell potential and as such these soils would be susceptible to volume change associated with seasonal fluctuations in soil moisture content which could be exacerbated by tree root action. The design of foundations constructed within the areas of Boulder Clay may, therefore, need to take into consideration the proximity of any existing trees/hedges or those which have been recently removed or any new plantings to any intended new structures. In this regard the NHBC Standard Chapter 4.2 'Building near Trees' provides useful guidance on building near trees particularly in shrinkable clayey soils. This is only likely to affect the dwellings proposed on Plots 22, 23 and 24. If we consider the detached property proposed on Plot 24, at its closest point this will come within approximately 2.4m from a line of trees to the west including Norwegian Maple (16m-18m), which have recently been removed. Using NHBC Chapter 4.2 Appendix 4.2C Chart 2 for soils with a medium shrinkage / swell potential, the derived foundation depth to accommodate the presence of the recently removed trees would be approximately 1.70m (including adjustments for climatic variations). At this depth the deposits of glacial Boulder Clay are somewhat stiffer, therefore a foundation bearing pressure of approximately 160kN/m^2 could be accommodated at this depth. Neither the main property, nor the integrated garage on the eastern elevation of this property will lie within influencing distance of a nearby Hawthorn Hedge which has recently been reduced in height from approximately 4m to 1.5m in height.

Considering the detached property proposed for Plot 23, the eastern corner of this property will be located approximately 3.3m away from the centreline of the adjacent Hawthorn hedge (which is possibly scheduled to be removed having been reduced from its original height of 4m to now approximately 1.5m). Using NHBC Chapter 4.2 Appendix 4.2C Chart 2 for soils with a medium shrinkage / swell potential, the derived foundation depth to accommodate the presence of the Hawthorn hedgerow (assuming it is to be removed at a maximum height of 4m) would be 1.45m (including adjustments for climatic variations). On Plots 23 and 24, as the distance of the foundations from the trees / hedgerow increases, the depth of the foundations could be reduced in line with the recommendations of Chart 2. As a preliminary guide, on Plot 23, foundation depths would return to a standard depth of 0.90m at a distance of approximately 5m from the Hawthorn Hedgerow.

Shared Garage of Plot 22 & 23

The shared detached garage structure for Plots 22 and 23, is also located within influencing distance of the mature Hawthorn hedgerow which extends along the eastern site boundary. If the use of deep trench fill foundations is considered to be uneconomical or impractical for the garage, consideration could be given to employing a near surface reinforced raft construction. Although some risk of differential settlement could occur due to the continued cyclic dehydration and rehydration of the near surface soils due to the presence of the Hawthorn, a suitably reinforced raft

should, by virtue of it inherent stiffness and load spreading capability be capable of accommodating potential soil movements. In order to mitigate the potential influence of the Hawthorn hedgerow a greater than normal thickness of stone infill may be required beneath the eastern corner of the garage. This is usually calculated as 50% of the derived foundation depth which in this case equates to approximately 1100mm of stone infill.

Ground Floor Construction

Although the covering of topsoil was relatively shallow this was occasionally underlain by deposits of slightly disturbed silty and clayey sand. These deposits were found to be relatively 'soft', or 'loose' therefore the use of ground bearing floor slabs is not recommended for the intended dwellings. Instead a fully suspended ground floor construction would be preferable, as this would eliminate the potential for differential settlement which could occur should 'soft spots' be present within the underlying sub-grade. The use of a suspended ground floor slab would also mitigate the potential effects of potential soil movements particularly beneath those dwellings constructed over clay soils located within influencing distance of trees or other significant vegetation.

Pavement Design (CBR)

In order to assist with the design of roads and paved areas, CBR tests were performed at four locations in accordance with the method TRL 587 CBR Tests DCP (Dynamic Cone Penetration). The results of the tests have been provided on the accompanying spreadsheets and graphs. At an anticipated formation level of approximately 0.20m to 0.30m beneath the existing surface, approximate CBR values (to the nearest 1%) ranged between 3% and 7%. This being the case, it may be prudent to adopt the lower value of 3% for preliminary design purposes as the compaction of the near surface deposits may vary somewhat across the general area of the site.

Percolation Trials (Soakaways)

Results of the recent borehole soakage (soakaway) trials indicate that the predominantly granular deposits of silty, fine sand which are present beneath the surface over the majority of the site (southern bulk of site) are quite permeable. The results of the soakage tests performed in a number of the completed boreholes recorded soil infiltration rates varying between 2.72×10^{-3}mm/s and 4.19×10^{-2}mm/s. It is noted that 'perched' groundwater infiltrations were encountered at depths of between 1.20m and 2.30m beneath the surface and on penetration water levels rose to depths of between 1.53m and 1.20m beneath the surface. In certain parts of the site, the shallow 'perched' groundwater level will restrict the effective storage capacity somewhat. This being the case, the use of shallower, longer 'trench style' soakaways could provide a more practical alternative to conventional, deeper chamber type soakaways. In northern most areas of the site where Boulder Clay was encountered directly beneath the near surface topsoil, the use of soakaways will not be feasible.

Design Sulphate Classification

Chemical tests performed on representative samples of the near surface soils and made / disturbed ground as part of the environmental screening, recorded water-soluble sulphate concentrations between 10mg/l and 70mg/l (2:1water / soil extract) with pH between 6.6 and 7.3. Tests performed on the samples of 'perched' groundwater recorded sulphate concentrations of 48mg/l and 63mg/l with pH values of 8.5. These values fall within design sulphate classes DS-1 of the BRE Digest Special Digest 1 classification 'Concrete in Aggressive Ground'. In accordance with the guidelines contained in Part 1 of the Digest and taking into account the geology and specific soil and groundwater conditions, the site can be assigned an ACEC (Aggressive Chemical Environment for Concrete) Class AC-1.

1.0 Brief

Following the instructions of Ward Homes Yorkshire, a geo-environmental assessment was carried out in connection with a proposed new residential development which is being planned on land at Sproatley Road, Preston, East Yorkshire The proposed new development will include the construction of 24 No. detached and semi-detached residential properties, each with individual

private gardens. Off street parking will be available either through the use of private driveways and garages or designated parking areas. A number of small landscaped areas will also form part of the development.

The scope of this intrusive investigation was designed in accordance with the requirements of the recommendations of a Phase 1 Desk Study report prepared by TLP Ground Investigations Ltd., on 26th November 2020 entitled 'Phase 1 Desk Study - Proposed Residential Development, Sproatley Road, Preston, East Yorkshire.', the findings of which are summarised in Section 3.0 of this report.

The intrusive borehole investigation was carried out between 4th and 16th December 2020 and included the collection of undisturbed soil samples and ground gasses from boreholes followed by chemical and geotechnical analysis of selected samples. This report presents the results and findings of this investigation and an assessment of the geotechnical and contamination restraints associated with the proposed development.

2.0 Site Description

The proposed development site is situated to the south of Sproatley Road in the northern outskirts of the village of Preston, East Yorkshire. The roughly irregular shaped site has an approximate area of 0.774 ha and is centred at National Grid Reference 518763, 430858. The site currently comprises a medium sized horse paddock with a number of stable structures situated in the northern most corner of the site adjacent to Sproatley Road. The site can be accessed directly from Sproatley Road through a metal gate, which is set within the post and wire fencing which extends along the north-western boundary of the site. A row of mature trees is currently growing along the north-western boundary and the majority of the remaining boundaries around the edges of the field are defined by mature hedgerows including Beech, Leyland Conifer and Hawthorn. Beyond the southern and western boundary are residential houses.

The site surface is generally level with a slight fall in level towards the northern site boundary. The field is grass covered with some patches of bare earth where more frequent trafficking has occurred.

The site is situated within a rural residential setting, with open field extending to the east and southeast. Residential developments are situated to the south and west of the site with sporadic residential located along Sproatley Road to the north of the site.

3.0 Issues Arising from Phase 1 Assessment

- According to historical mapping, no permanent structures have ever been erected on the study site. Throughout its history, the site has remained undeveloped and used only for agricultural purposes, as a Plant Nursery and more recently as a horse paddock with a number of small stables erected in the northern part of the site.

- From the mid Nineteenth Century, the areas surrounding the site have predominantly been used for agricultural, residential and small holding purposes. Other than the nearby Nurseries, small holdings, and residential dwellings, no other significant commercial, industrial or residential developments have been identified in the areas surrounding the site that could feasibly have impacted on the study site. Shallow drainage ditches are present within the fields surrounding the site. It is therefore possible that some minor contamination may have migrated onto the site through these pathways. Considering the semi- rural setting of the site, this is considered to be highly unlikely that significant contamination would be present within these water courses. Although a number of surface ponds have been identified in the areas surrounding the site, none appear to have

been significantly in-filled. No potential generation sources of harmful ground gasses have therefore been identified.

Table 1

Table 1 - Summarises the potential contaminative land uses on and in the vicinity of the site showing potential sources with associated contaminants.

Sources							
Sources Description	Contaminants Associated with Source						
	Metals	PAH	TPH	Asbestos	Landfill Gas	Pesticides / Fertilizers	TPH Vapours
On Site							
Contamination resulting from the use of the site for agricultural purposes, as a nursery and as a horse paddock. Possible TPH contamination resulting from leaks or spillages from the historical use of agricultural vehicles and machinery.	✓	✓	✓				✓
The possible presence of deposits of made / disturbed ground that may exist beneath parts of the site surface.	✓	✓	✓	✓			
Burning processes that have taken place within the site boundaries.	✓	✓					
Residual contamination from natural weathering of geological strata.	✓						
Off Site							
Contamination that may have migrated onto the site from the nearby residential developments / small holdings.	✓	✓	✓	✓			✓

Table 1 - Summarises the potential contaminative land uses on and in the vicinity of the site showing potential sources with associated contaminants.

Key for Table 1

Metals

Includes - Metals and metalloids (Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc, Arsenic, Boron, Selenium and inorganic chemicals such as Cyanide

PAH

Includes – EA16 – Acenaphthene, Acenaphthylene, Anthracene, Benzo[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[g,h,i]perylene, Benzo[k]fluoranthene, Chrysene, Dibenzo[a,h]anthracene, Fluoranthene, Fluorene, Indeno[1,2,3-cd]pyrene, Naphthalene, Phenanthrene, Pyrene.

Table 2

Details the potential pathways with receptors identified for any contaminants that may be present in the ground at the site during and following the proposed development.

Pathways		**Receptors**	
Human Health		**Human Health**	
Dermal Contact with soil	✓	End users and construction workers	✓
Ingestion of soil	✓	End users and construction workers	✓
Inhalation of Contaminated Dust	✓	End users and construction workers	✓
Ingestion of site grown vegetables	✓	No home grown produce envisaged	✓
Ingestion of water from affected service pipes	✓	End users	✓
Buildings		**Buildings**	
Mobile water soluble sulphates	✓	Concrete foundations	✓
Controlled Waters		**Controlled Waters**	
Lateral and vertical migration	✓	Surface water receptors & shallow / deeper groundwater regime	✓
Infiltration	✓	Surface water receptors & shallow / deeper groundwater regime	✓

Table 2 - details the potential pathways with receptors identified for any contaminants that may be present in the ground at the site during and following the proposed development.

4.0 Intrusive Investigation

4.1 Sampling Strategy

In order to quantify the potential contamination risk, an intrusive investigation was undertaken in accordance with BS5930:1999+A2 2010 Code of Practice for Site Investigations, BS EN 1997-2:2007 'Eurocode 7 – Geotechnical Design – Part 2 – Ground Investigation and Testing' British Standards Institution and BS10175:2011 Code of practice for the Investigation of Potentially Contaminated Sites. The intrusive investigation included the sinking of sampling boreholes and was completed between 4th and 16th December 2020. The sampling strategy was designed on the basis of the investigation objectives identified in the Phase 1 Desk Study which were to:-

- Obtain representative samples of soil and groundwater (if possible) from strategic areas for subsequent analysis.
- Gather further information on contaminated land conditions and geotechnical data to assist in the design and construction of the proposed new buildings and infrastructure.
- Re-evaluate the preliminary conceptual site model and undertake a qualitative contamination risk assessment.
- Determine whether mitigation measures or remediation is required in areas where soil / groundwater / ground vapours contamination may exist, in order to render the site suitable for its proposed residential end use.

Once the development is completed, significant areas of the site will be covered with either foundation concrete/ floor slabs or areas of permanent hard surfacing i.e. access roads, driveways and parking areas. However, the current proposals also include for the provision of individual private garden areas and areas of soft landscaping. These areas are considered to be the most sensitive areas of the development where future users of the site may come into contact with any

potential residual contamination. Apart from potentially contaminative activities that may have taken place within the 'out buildings' occupying the site and activities associated with the former Plant Nursery in general, the Phase 1 Desk Study did not identify any other specific areas / sources of potential contamination. It was therefore considered that the borings should be located as to provide a general overview of the ground conditions and contamination status of the site as a whole. For analytical purposes, in terms of metals, semi metals, general contaminants, asbestos, PAH, TPH and harmful vapours, the entire site has provisionally been considered as one 'averaging area'.

The locations of the borings have been indicated on the enclosed site layout drawing / aerial photograph and details of the strata encountered have been provided on the enclosed borehole record sheets.

4.2 Fieldwork

The recent intrusive fieldwork included the following:-

- The sinking of 14 No. shallow sampling boreholes using windowless sampling equipment to depths of between 2.10m and 3.55m beneath the ground surface. At the individual borehole locations soil and (where possible) groundwater samples were obtained. The soil samples were recovered as continuous cores reducing in size from 100mm to 63mm in diameter within rigid PVC core liner. Fragmental samples were obtained from the cores using appropriate tools (e.g. stainless steel trowel) and placed in appropriate containers, sealed, labelled and stored in cool boxes at low temperatures. The samples selected for analysis were subsequently transferred under chain of custody to an analytical laboratory.

- *In situ* CBR testing of the near surface sub-grade using TRL 587 method at 5 No. locations.

- Performing 'falling head' permeability tests in 4 No. of the completed test holes in order to assess the permeability characteristics of the near surface stratum.

4.3 Soil Sample Acquisition

A number of near surface samples were retained from each borehole and from these, a total of 12 No. soil samples were selected for analysis. The selected samples were generally obtained from the near surface soils as these were considered represent the most likely soils to be contaminated and most likely to come into contact with construction workers and end users of the site. These near surface soils were also deemed to represent a potential source of contaminated leachate which could enter any underlying sensitive groundwater regime. Occasionally, slightly deeper samples were obtained from areas where potable water supply pipes were likely to be located or where slightly thicker deposits of made ground were identified. Groundwater seepages were encountered within the majority of the sampling boreholes. Two samples of the 'perched' groundwater were selected for subsequent analysis.

5.0 Ground Conditions

5.1 Geology

Maps published by British Geological Survey indicated that the superficial deposits overlying the site would comprise 'Glacial Till' of Diamicton (un-stratified deposits) in the northern part of the site. In the southern part of the site, this could possibly be represented by a covering of Glaciofluvial Deposits of Sand and Gravel. The underlying natural bedrock is represented by the Flamborough Chalk Formation, which is of Santonian age (Cretaceous).

The maximum permeability of the superficial deposits is described as 'very high' and the maximum permeability of the underlying bedrock is described as 'very high'.

No geological faults or linear features have been identified within 500m of the study site. No historical ground workings have been identified within 250m of the study site although a number of small ponds are indicated within the fields surrounding the site. The nearest of which is a small pond located 150m to the east which still appears as a surface depression on aerial photography suggesting it has not been in-filled. All other surrounding small ponds do not appear to have been in-filled and as such these features do not represent a potential source of harmful ground gasses.

The *Groundsure* report indicates that no mining, extraction or natural cavities are present within 1000m of the study site.

Ground Conditions

Topsoil / Made / Disturbed Ground

At the surface each of the sampling locations encountered deposits of topsoil / disturbed ground extending to depths of between 0.25m and 0.35m beneath the surface. This comprised deposits of mid to dark brown, silty, sandy and clayey topsoil containing occasional fine to medium stone fragments. In a number of borings, this was underlain by slightly disturbed deposits of 'loose', mid brown, silty, sandy and clayey soil containing occasional fine to medium assorted stone fragments. At the location of BH1, where disturbed ground extended to 0.90m depth, these deposits contained occasional fine fragments of brick and coal. Where present, the deposits of disturbed ground extended to depths of between 0.45m and 0.90m beneath the surface.

Natural Deposits

Over the majority of the site, the natural superficial deposits were initially represented by a sequence of Glaciofluvial Deposits initially comprising deposits of loose, brown and rust brown, silty, fine sand. At depths of between 1.10m and 2.20m beneath the surface these deposits developed into 'loose' to 'medium dense', mid brown, very silty, fine sand / sandy silt. Eventually, at depths of between 3.20m to 3.25m beneath the surface, the borings penetrated deposits of 'soft', brown, laminated, silty clay or 'soft to firm', brown, silty, slightly sandy Boulder Clay.

In the northern part of the site, the surface deposits of sand were largely absent. Here the deposits of topsoil and disturbed ground were underlain by weathered deposits of Glacial Till, predominantly represented by Glacial Boulder Clay. This initially comprised deposits of 'firm' mid brown, silty, very sandy clay / clayey sand containing occasional fine stone fragments. These deposits quickly developed from a 'firm' into a 'stiff', brown, mottled grey, silty, slightly sandy Boulder **Clay** containing occasional fine fragments of chalk coal and other assorted stones. Once penetrated, the Boulder Clay subsequently extended to the full depth of borehole penetration. Deposits of Boulder Clay were also encountered in BH4 beneath the covering of Glacio-fluvial sand at a depth of 3.25m beneath the surface. BH4 was located close to the interface between the more sandy near surface deposits and the near surface Boulder Clay. A simple graphic showing the site split between the near surface 'silty sand' and near surface 'clay' can be found on the appended Borehole Location Plan.

5.2 Groundwater

'Perched' water seepages were encountered within the majority of the borings, with the strongest infiltrations encountered within the deposits of silty sand and sandy silt. Within these granular soils, 'perched' groundwater seepages were encountered at depths of between 1.70m and 2.30m beneath the surface and on completion, the groundwater levels in the open borings were measured at depths of between 1.19m and 2.15m beneath the surface.

In the northeast corner of the site where the deposits of glacial Boulder Clay were encountered, surface water seepages were observed towards the base of the topsoil or superficial weathered sandy deposits at the interface with the more impermeable deposits of clay beneath. These near surface infiltrations although relatively slow, did begin to accumulate in the open borings, with levels rising to depths between 0.30m and 1.30m beneath the surface. Within the deposits of Glacial Boulder Clay, no significant or sustained ground water seepages were encountered.

6.0 Geotechnical Testing

- Atterberg Limit tests were performed on representative samples of the silty and sandy Boulder Clay recovered from the borings and the recorded Plastic Index values (PI's) have been indicated on the enclosed summary laboratory data sheet. Plastic Index ranged between 26.9% and 27.1% indicating that the material has a '**medium volume change potential'** (NHBC Standards Chapter 4.2 'Building near Trees').

- Hand vane tests were performed on undisturbed samples obtained from the deposits of silty and sandy Boulder Clay, laminated silty clay and occasionally, on samples of the more cohesive materials recovered from the Glaciofluvial horizon. Tests performed on samples recovered from the more weathered Boulder Clay at shallow depth recorded hand vane values in the range 40kN/m^2 to 58kN/m^2, indicating a range in consistency between 'soft' and 'firm' for the deposits. Tests performed on samples of less weathered material recovered from slightly greater depth, recorded values more typically between 55kN/m^2 and 124kN/m^2, indicating a range in consistency between 'firm' and 'stiff' for the deposit.

  Tests were also performed samples of laminated, silty clay recovered from towards the base of the Glacio-fluvial sequence recorded hand vane values of between 45kN/m^2 and 55kN/m^2, indicating a generally 'soft to firm' or 'firm' consistency for these deposits.

- The compaction of the Glacio-fluvial sand which was present at shallow depth over much of the site, was assessed using Standard Penetration Tests (SPT's). These were performed at regular intervals as the borings were advanced. The results of the tests have been interpreted as 'N' Values (blows for 300mm penetration) and these have been recorded on the enclosed borehole record sheets. Within the upper deposits of silty, medium sand and sand and gravel, SPT 'N' values ranged between 4 and 8, indicating a generally 'loose to medium dense' state of compaction for the deposit. Within the underlying deposits of sandy silt, 'N' values ranged between 3 and 26 indicating a range in compaction from 'very loose' to 'medium dense' for the deposit. A test performed within the deposits of made ground recorded an 'N' value of 11 (medium dense), and tests performed within the deposits of laminated, silty clay, ranged between 3 and 11, which are consistent with the range in consistency i.e. 'soft' to 'stiff', indicated by the recorded hand vane values.

- In order to assist with the design of roads and paved areas, CBR tests were performed at four locations in accordance with the method TRL 587 CBR Tests DCP (Dynamic Cone Penetration). The results of the tests have been provided on the accompanying spreadsheets and graphs. At an anticipated formation level of approximately 0.20m to 0.30m beneath the existing surface, approximate CBR values (to the nearest 1%) ranged between 3% and 7%. This being the case, it may be prudent to adopt the lower value of 3% for preliminary design purposes as the compaction of the near surface deposits may vary somewhat across the general area of the site.

- In four of the sampling borings (BH1, BH3, BH6 & BH7), 'falling head' (variable head) permeability tests were performed in order to assess the relative permeability of the near surface stratum *in situ*. In order ensure the side walls of the boreholes remained stable throughout the tests, lengths of 50mm diameter slotted standpipe were inserted in the borings and the annulus surrounded by fine grained well screen gravel. The borings were then filled with water and the time taken for the water to dissipate from the test holes was

subsequently monitored. The results of the tests have been tabulated on the enclosed spread sheets and also illustrated on the enclosed percolation graphs.

The results of the tests indicate a rapid infiltration rate (*f*) for the natural deposits of silty sand / sandy silt of between 2.72 x 10^{-3}mm/s and 4.19 x 10^{-2}mm/s. These results would suggest that **the deposits of silty sand / sandy silt** would theoretically provide a satisfactory media for the dissipation of surface water from 'soakaways'. Although the site is not located within 500m of a Groundwater Source Protection Zone, advice should be sought at an early stage in the development in order to establish the classifications of water that are permitted to be discharged into these superficial deposits.

It should be noted that in certain locations on site, there is a relatively high 'perched' groundwater table within the Glacio-fluvial deposits and therefore soakaways should be designed to exploit the permeable sandy deposits above this level.

The relatively impermeable Boulder Clay encountered in the northern part of the site will not provide an effective soakaway media. A basic graphic showing the approximate split between the near surface sandier material and the near surface more clay soils is shown on the appended Borehole Location Plan

- Chemical tests performed on representative samples of the near surface soils and made / disturbed ground as part of the environmental screening, recorded water-soluble sulphate concentrations between 10mg/l and 70mg/l (2:1water / soil extract) with pH between 6.6 and 7.3. Tests performed on the samples of 'perched' groundwater recorded sulphate concentrations of 48mg/l and 63mg/l with pH values of 8.5.

- In order to establish the suitability of the surface topsoil for re-use, two samples of the near surface topsoil were submitted for compliance testing in accordance with BS3882:2015. The results of the tests have been presented on the declaration of compliance numbered 91712-1 and 91712-10. The results of the tests indicate that the majority of the determinands are generally compliant with multi-purpose topsoil, the slight deficiency in phosphorus should be able to be overcome by the use of soil improvement fertilizers and should not preclude its use as a reasonable quality topsoil.

  It should be noted however that the sample obtained from BH1 (0.20m-0.30m) was found to contain a slightly elevated concentration of Lead that is above the current ATRISKSoil SSV for a residential end use with the consumption of home grown produce. Topsoil in this part of the site should therefore be separated from that of the remainder of the site, stockpiled and precluded from being used as a topsoil dressing. (see Remediation Plan within appendix). As the samples of topsoil obtained from the remaining parts of the site were found to contain concentrations of contaminants well within current ATRISKSoil SSV's, these materials could be considered as a suitable 'site won' general purpose topsoil once the development is completed.

7.0 Contamination

7.1 Preliminary Conceptual Site Model

The preliminary Conceptual Site Model (PCSM) detailed in the Phase 1 Assessment Report provides information regarding the potential 'source-pathway- receptor' linkages that may be present at the site. The principal potential contaminant sources were identified as follows:-

- *From an examination of the site's history, sources of 'on site' contamination would appear to be very limited as the site has only ever been used for agricultural purposes, as a Nursery and as a paddock. It is possible that burning processes may have taken place, such as stubble burning.*

- *Historically, the areas surrounding the site have mainly been used for agricultural purposes, residential developments and small holdings. It is possible that some minor contamination may have migrated onto the site from the development of these areas or through the network of drainage ditches which flow along the site boundaries.*

- *Weathering of the natural geological stratum can occasionally cause enrichment of certain metals in the near surface strata, however, this is considered unlikely bearing in mind the information given in the 'Groundsure' report which in 'Section 20' (Estimated Background Soil Chemistry) shows very low anticipated levels of Arsenic, Cadmium, Chromium, Nickel and Lead.*

The contaminants that might be associated with the past activities at the site and the surrounding areas could include but are not necessarily limited to the following:-

- *Metals, metalloids and asbestos associated with any possible deposits of 'disturbed ground' that may be present beneath parts of the site surface. Contamination from natural weathering of the geological stratum. Slight contamination that may have migrated onto the study site from the construction and use of the various residential developments and small holdings that have been operational in the immediate surrounding areas.*

- *Polycyclic Aromatic Hydrocarbons derived from the incomplete combustion of organic materials, i.e. from bonfires or stubble burning that may have taken place at the site in the historical past.*

- *Possible TPH contamination emanating from accidental leaks or spillages from the use of agricultural farming equipment.*

7.2 Contamination Testing and Assessment Strategy

In accordance with the recommendations of Phase 1 Desk Study, a programme of chemical analysis was adopted that would target certain contaminants present in the soil that might be associated with the past and current uses of the site.

- From the 14 No. boreholes, a total of 12 No. representative soil samples and 2 No. groundwater samples were selected from the borings and these were submitted for a range of tests which included metals, semi-metals, PAH compounds (speciated to EPA16), speciated and characterised TPH and asbestos.

- Two slightly deeper samples were analysed for a range of contaminants often requested by water companies (UKWIR Suite) in order to assist in the selection of the most suitable materials for use in underground potable water supply pipes.

All soil samples were placed in approved containers and cool boxes and despatched under a chain of custody to an accredited laboratory (Chemtech Environmental Ltd) for the range of tests outlined above. The results of the analyses have been provided on the enclosed laboratory certificates with contract number 91712 – Sproatley Road.

7.3 Assessment of Data

For the assessment of human health, the dataset has been compared to Soil Screening Values (SSV's) developed by **AT**RISK^{SOIL}. Atkins soil screening values (SSV's) have been derived in line with the EA 2009 guidance (SR2, SR3, SR4, and SR7) using the CLEA v1.071 software. The modelling inputs were made compliant with the SR3 residential, commercial and other conceptual site models and follow the guidance provided within SR3 where possible. The

SSV's currently available include values for a range of metals and semi metals, speciated PAH's, characterized TPH, BETX and other organic contaminants.

The C4SL project methodology released by DEFRA in December 2014 was a step-change in the approach to the assessment of land contamination in the UK. The C4SLs introduced a change to toxicological appraisal that defined 'low risk', updated exposure parameters for the standard SR3 land uses and, following a review of relevant literature and Atkins own SSV approach, introduced the Public Open Space (Residential) and Public Open Space (Parks) land uses. These changes in exposure and land use were formalised in an update to the CLEA software with the release of CLEA v1.071 in September 2015.

Atkins have updated the SSVs using CLEA v1.071 to incorporate the following changes:

- Updated exposure assumptions for the standard residential, commercial land uses as set out in the C4SL project methodology for 1% SOM sand and 6% SOM sandy loam soil types;
- Updated exposure assumptions for the standard allotments land use as set out in the C4SL project methodology for the 6% SOM sandy loam soil type;
- Derivation of the 'top two' produce for all contaminants for the residential and allotments land uses and inclusion of this method in the consumption of home grown produce pathway; and
- Inclusion of SSVs derived for the Public Open Space (residential) and Public Open Space (parks) land uses as set out in the C4SL project methodology at 1% SOM sand and 6% SOM sandy loam soil types.

Furthermore, as part of their routine updates they have updated the toxicological assessment of ten contaminants (based on minimal risks as set out in Environment Agency SR2 Guidance).

Further C4SLs based on 'Low Levels of Toxicological Concern' are to be derived by an industry led initiative in the future and Atkins is fully supportive of this effort.

Certain organic contaminants can be compared to the EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment 2010 for a residential or commercial end use. They provide an indication of the chemical concentration in soil below which the long-term human health risks for site occupants (for various generic land-use scenarios) are considered to be tolerable or minimal.

Once the development is completed, significant areas of the site will be covered with either foundation concrete / floor slabs or areas of permanent hard surfacing. However, the new properties will incorporate individual private garden areas and also some small areas of soft landscaping / public open space will be provided in certain parts of the site. These areas are considered to be the most sensitive areas of the site where future users of the site may come into contact with any residual contamination that may be present. It is possible that the gardens could be used for the growing of home grown produce and therefore in terms of contamination sensitivity the published SSV's / C4SL applicable to a 'residential with the consumption of home grown produce' (res-with) end use scenario, have been adopted for the assessment of the contamination test data. The dataset has been compared to 6% soil organic matter (SOM) 'res-with' values as the majority of the recorded OMC concentrations were above 3% so this approach was considered appropriate.

BRE Digests Special Digest 1 can be reference to assess the risk from sulphate and acid attack on buried concrete.

Guidance issued by UKWIR Publication 2010 'Guidance for the selection of water supply pipes to be used in Brownfield sites' can be used to assess the risk to underground water supply pipes.

7.3.1 Statistical Analyses

Where appropriate, statistical analysis of the dataset has been carried out in accordance with the methodology outlined in 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', CL: AIRE May 2008.

For a planning scenario, the developer should consider the following key question:

'Is there sufficient evidence that the true mean concentration of any given contaminant is less than the Critical Concentration?'

In statistical terms, these types of question are handled through the use of formal hypotheses – the Null Hypothesis and the Alternative Hypothesis. Statistical tests are structured as to be able to show (with a defined level of confidence), which of the hypotheses is likely to be true in any particular case. The outcome of the testing is always expressed in terms of whether the Null Hypothesis can be rejected or not.

Under the land use planning system, where the aim is to demonstrate 'suitability of use':

- The Null Hypothesis is that the level of contamination [in the land of interest] **is the same as or higher than**, the critical concentration; and
- The Alternative Hypothesis is that the level of contamination **is lower than** the critical concentration.

If the statistical test shows that the Null Hypothesis should be rejected, it concludes that the Alternative Hypothesis is more likely to be true, i.e. that contaminant concentrations are low relative to the critical concentration and that the land is suitable for use.

If the test shows that the Null Hypothesis should not be rejected, it should be concluded that contaminant concentrations may be the same as, or higher than the critical concentration and further remedial measures may be needed.

Where the recorded concentrations of the samples submitted for testing fall below the limit of analytical detection, these values have been replaced with small numbers of similar order.

'Outliers' have only been excluded from the dataset when they are obviously and demonstrably the result of an error that can be identified or explained, or where they clearly indicate that more than one soil population exists within the dataset.

The spreadsheets showing the statistical analysis of the contamination test results have been provided in the appendix.

7.4 Contamination Results

7.4.1 Soils

7.4.1.1 *Metals and Semi metals and General Contaminants*

10 of the 12 No. soil samples submitted for testing were analysed for a general metals and semi-metals suite that might be associated with contamination resulting from the past uses of the site. The results indicate that apart from for Lead, none of the other determinands included in the testing schedule were in concentrations above current Soil Guide Values (SGV's) published by the

Environment Agency, Atrisk SSV's or provisional C4SL values published by DEFRA for a 'res-with' end use scenario and a soil organic matter (SOM content of 6%).

In the sample obtained from borehole BH1 (0.20-0.30m) a Lead concentration of 330mg/kg was recorded, which is slightly above the current ATRISKSoil SSV of 200mg/kg.

When this result is placed within a statistical analysis, the dataset for Lead is found to be "not normally" distributed and therefore Chebychev Theory would be more appropriate than T-Test. Within the Chebychev statistical analysis, the dataset fails for Lead suggesting that some form of remediation will be required on site for Lead contamination.

Owing to the elevated concentration of Lead being isolated to only 1 No. sample (BH1 0.20 – 0.30m) and bearing in mind that at this location there was a greater thickness of disturbed ground, it may be more appropriate to segregate this area of the site as a 'hot spot' for remediation and consider the remainder of the site appropriate for its proposed residential end use without the need for any remediation for Lead contamination.

It is therefore recommended that appropriate remediation is undertaken in the vicinity of BH1 in order to mitigate the potential risk from Lead in this part of the site. The methods for undertaking this are discussed in section 8.1 and 8.2 of this report.

Apart from this localised area of elevated Lead contamination, in other parts of the site concentrations of metals, semi-metals and general contaminants, were found to be low relative to their critical concentrations and suitable for the proposed 'res-with' end use.

7.4.1.2 ***Polycyclic Aromatic Hydrocarbons (PAH's)***

10 of the 12 No. soil samples submitted for testing were analysed for speciated PAH's (EPA16) and the results compared to current Atrisk SSV's. On comparing the recorded values with current Atrisk SSV's, **all** of the samples recorded PAH concentrations within current Atrisk SSV's for a 'res-with' end use scenario (SOM 6%).

In terms of PAH contaminants it is considered that contamination in the near surface soils across the site is low relative to their critical concentration and that the land is suitable for the proposed 'res-with' end use without prior remediation.

7.4.1.3 ***Total Petroleum Hydrocarbons (TPH's)***

10 of the 12 No. soil samples submitted for testing were analysed for characterised TPH compounds and the results compared to current SSV's. Whilst there were very occasional slight detectible concentrations of TPH fractions identified in some of the samples submitted for testing, on comparing the recorded values with current guideline values, **none** of the determinands included in the suite of tests were found to be in concentrations which exceed the current Atrisk SSV's for a 'res-with' end use scenario (SOM 6%)**.** Indeed the vast majority of the determinands were found to be in concentrations which were below the limit of analytical detection and **with respect to these contaminants, the site can be considered suitable for its proposed end use without the need for any specific remediation**.

The absence of any significantly elevated TPH fractions within the soil samples submitted for testing suggests that the risk of hydrocarbon vapours entering the proposed new buildings is very low.

A TPH vapour survey is not considered necessary at this time and no specific protection from hydrocarbon vapours is considered to be warranted for the proposed new development.

7.4.1.4 ***Asbestos***

10 of the 12 No. soil samples were submitted for examination the presence of asbestos in soil using polarised light microscopy. No traces of asbestos were detected in any of the samples.

7.4.1.5 ***Sulphate***

Chemical tests performed on representative samples of the near surface soils and made / disturbed ground as part of the environmental screening, recorded water-soluble sulphate concentrations between 10mg/l and 70mg/l (2:1water / soil extract) with pH between 6.6 and 7.3. Tests performed on the samples of 'perched' groundwater recorded sulphate concentrations of 48mg/l and 63mg/l with pH values of 8.5. These values fall within design sulphate classes DS-1 of the BRE Digest Special Digest 1 classification 'Concrete in Aggressive Ground'. In accordance with the guidelines contained in Part 1 of the Digest and taking into account the geology and specific soil and groundwater conditions, the site can be assigned an ACEC (Aggressive Chemical Environment for Concrete) Class AC-1.

7.4.1.6 ***WIR Suite***

Two of the 12 No. soil samples were submitted for a WIR suite of tests that are commonly used to assist in the materials selection for potable water supply pipes. The results of the test would suggest that PE should be suitable for underground potable water supply. This should be confirmed at an early stage with the local water company.

7.4.2 **Groundwater**

Two samples of the 'perched' groundwater from boreholes BH2 (1.43m) and BH7 (1.74m) were analysed for a similar range of contaminants as the soil samples.

The results of the analysis have been compared to current ATRISK WSV's for a residential end use, EQS for fresh and salt water and also UK Drinking water standards.

The majority determinands were recorded either below their respective limit of analytical detection or well below current ATRISK WSV's, EQS freshwater / saltwater standards or UK DWS for consumers taps. It is noted, however, that in the sample obtained from BH2 (1.43m), a Copper concentration of 10.2µg/l was recorded which slightly exceeds the EQS value for fresh and salt water. Nevertheless this value is still well below the allowable limit for consumer's taps of 10.2µg/l.

It is also noted that the concentrations of Lead within the samples of groundwater were below the level of detection and therefore well within current UK DWS indicating that the slightly elevated concentrations of Lead identified in the soil sample at the location of BH1 has not impacted on the groundwater quality beneath the site.

7.4.3 **Ground Gas / Vapours**

The Emapsite Report has not identified any significant areas of surface ground workings, landfill sites or areas of potentially in-filled ground within 250m of the study site. No potential sources of land gas generation have been identified that could feasibly impact upon the site and no intrusive quantitative risk assessment was deemed necessary in the previous Phase 1 Desk Study.

The absence of any significantly elevated TPH fractions within the soil and groundwater samples submitted for testing suggests that the risk of hydrocarbon vapours entering the proposed new dwellings is negligible. A TPH vapour survey is not considered necessary and no additional protection from hydrocarbon vapours is deemed to be required within the proposed development.

8.0 Contamination Summary, Revised Conceptual Site Model & Risk Assessment

The Preliminary Conceptual Site Model and Risk assessment developed in the Phase 1 Desk Study identified possible pollutant linkages stemming from the historical land uses at the site itself and / or in the immediate environs.

The principal **potential** contaminants of concern were considered to be metals, semi-metals, PAH's, TPH, asbestos and potential toxic vapours.

The principal receptors of potential contamination from soil and groundwater were identified as current and future end users of the site, ground workers, controlled surface and ground waters / Principal aquifer, structures and buried concrete. The highest risk classification afforded to these possible pollution linkages was perceived to be 'Moderate / Low'.

The investigation has identified a localised **elevated concentration of Lead in the near surface sample obtained from BH1**. Elsewhere on the site, **Lead and all other determinands**, i.e. metals, semi-metals, general contaminants, PAH and TPH, were within the critical concentrations as defined by current ATRISKSoil guideline values for a 'res-with' end use scenario.

In the vicinity of BH1 limited remediation will be required in order to render the affected garden areas suitable for their proposed residential end use bearing in mind the possibility that produce could be grow for human consumption.

Although the recorded, Lead concentration of 330mg/kg recorded in the near surface sample was only slightly above the current ATRISKSoil SSV of 200mg/kg, it is recommended that as a precaution, a remediation strategy is developed in order to mitigate the potential risk from Lead contamination. The plots affected by the slight Lead contamination are considered to be the rear gardens to Plots 11 and 12. On completion of the development any remediation will require validation. In areas of the site where the development will provide a permanent barrier between potentially contaminated soils and the end users of the site, i.e. areas covered with buildings, foundation concrete, access roads and areas of permanent paving, no specific remediation will be required.

A remediation plan can be found in the appendix to this document.

On the basis of the information which has now become available in the Phase 2 Investigation, a revised conceptual site model and risk assessment has been developed which is outlined in the matrix below.

Revised Conceptual Site Model Based on Information Gathered in Phase 2 Intrusive Investigation

Source	Pathway	Receptor	Any significant contamination present Y/N	Previous Risk Class Phase 1 Desk study	New Risk Class Based on Phase 2 Investigation
Contamination resulting from the use of the site for agricultural purposes, as a plant nursery and as a horse paddock. Possible but unlikely TPH contamination resulting from leaks or spillages from the historical use of agricultural vehicles and machinery. The possible presence of deposits of made up / disturbed ground	Ingestion, Inhalation (dust) and / or Dermal Contact and Migration of Potentially Contaminated Leachate	Construction / Maintenance Workers / General Public during Excavations	Yes (Localised - Lead only in one sample BH1)	Low	**Low** – One of the twelve samples submitted for testing recorded a slightly elevated concentration of 'Lead' compared with current guideline values for a 'residential development with the consumption of home grown produce'. The result however does not exceed values for 'Commercial' or 'Public Open Spaces' end use. In order to mitigate any minor temporary risk, site / ground workers should be equipped with appropriate PPE (overalls, gloves, dust masks, eye protection) during the earth works. Adequate welfare should also be provided. If earthworks are carried out during very dry and windy conditions, dust suppression measures should be put in place and all haulage vehicles removing soils from site should be

beneath the site surface. Burning processes that have taken place within the site boundaries. Residual contamination from natural weathering of geological strata. Contamination that may have migrated onto the site from the nearby residential developments / small holdings. Potential Contaminants Include – PAH, TPH, metals, semi-metals and asbestos.					covered to limit the release of airborne particulates.
		Future Site Users	Yes (Localised - Lead only in one sample BH1)	Low	**(Localised) Moderate but Generally Low** – One of the twelve samples submitted for testing recorded slightly a elevated concentration of 'Lead' compared with current guideline values for a 'residential development with the consumption of home grown produce'. The localised areas affected by the elevated Lead contamination are considered to be the proposed rear garden areas of **Plots 11 and 12. These garden areas** will require remediation to limit the risk to acceptable levels. It has been determined that the maximum thickness of cover required to mitigate the risk from the recorded Lead contamination should be **252**mm (see enclosed spread sheet). Following remediation and subsequent validation the risk class attributed to future site users would be **Low**. Areas of the site covered by foundation concrete and permanent hard surfacing will not require remediation as an effective barrier will exist between potentially contaminated soils and the end users of the site.
		Landscaping Plants	(Localised - Lead only in one sample BH1)	Very Low	**Very Low** – Although slight Lead contamination was detected within the near surface deposits of made ground at the location of BH1, vegetation within the site boundaries did not appear to be exhibiting any signs of distress. The provision of a clean cover system with a topsoil dressing on the rear garden areas of Plots 11 and 12 should provide an effective barrier to direct contact with potentially contaminated soils and also serve to improve the nutrient status of the near surface deposits. In order to establish the suitability of the surface topsoil for re-use, two samples of the near surface topsoil were submitted for compliance testing in accordance with BS3882:2015. The results of the tests indicate that the majority of the determinands are generally compliant with multi-purpose topsoil, the slight deficiency in phosphorus should be able to be overcome by the use of soil improvement fertilizers and should not preclude its use as a reasonable quality topsoil. It should be noted however that the sample obtained from BH1 (0.20m-0.30m) was found to contain a slightly elevated concentration of Lead that is above the current ATRISKSoil SSV for a residential end use with the

					consumption of home grown produce. Topsoil in this part of the site should therefore be separated from the remainder of the site, stockpiled and precluded from being used as a topsoil dressing. (see Remediation Plan). As the samples of topsoil obtained from the remaining parts of the site were found to contain concentrations of contaminants well within current ATRISKSoil SSV's, these materials could be considered as a suitable 'site won' general purpose topsoil once the development is completed.
		Water supply Pipes	No	Low	**Low** – As a localised elevated concentration of Lead has been identified in the near surface soils, the local Water Authority will need to be contacted to ascertain the most appropriate materials for use in potable water supply pipes. It should be noted that BH1 (where slightly elevated Lead was encountered) is located in the south eastern corner of the site and away from any proposed water main runs from Sproatly Road. Reference should be made to UKWIR Publication 2010. Provided the correct procedures are implemented to protect water pipes from the identified contamination, then the risk class attributed to future site users would be **Low**. Comparing the results of a WIR suite of tests from two representative soil samples with available pipe selection tables would suggest that PE pipe could be adopted for potable water supply. However, the soil sample submitted for WIR testing was located outside the area where slight Lead contamination was identified and this should be considered when determining the most suitable material for potable water supply pipes. Provided the correct procedures are implemented to protect water pipes from the observed contamination, then the risk class attributed to future site users would be - **Low**.
		Underground Structures	No	Low	**Very Low** – Water-soluble sulphate concentrations were found to lie within the design sulphate class DS-1 of the BRE Digest Special Digest 1 classification 'Concrete in Aggressive Ground'. In accordance with the guidelines contained in Part 1 of the Digest and taking into consideration the specific soil and groundwater conditions, the site can be assigned an ACEC Class AC-1.
		Controlled waters (Surface / Groundwater)	Yes (Localised - Lead only in one sample BH1)	Moderate / Low	**Low** – Although a slightly elevated concentration of Lead was identified within the near surface deposits of made ground at the location of BH1, once this localised area has been suitably remediated the potential for the generation of contaminated leachate should be reduced. The recent tests performed on samples of the groundwater recorded concentrations of Lead below the limit of analytical detection. The development will involve covering significant parts of the site with permanent hard surfacing and structures, which will reduce the amount of rainwater entering the near surface deposits and hence reduce the potential for the generation of potentially contaminated leachate. The site is not situated within 500m of a groundwater

					SPZ. The nearest current abstraction point is situated 433m southwest of the site where water is abstracted from a borehole point source for general washing / process washing. The chalk aquifer which is present at depth beneath the site will be considered a highly sensitive receptor and should be afforded a high level of protection. The superficial soils have been designated as a Secondary A Aquifer in terms of water supply and would also be considered sensitive.
		Off Site Drains	Yes (Localised - Lead only in one sample BH1)	Low	Very Low - Once completed, large parts of the development will be covered with buildings and permanent hard surfacing which will limit the amount of rainwater entering the near surface deposits and hence reduce the potential for the generation of potentially contaminated leachate. A shallow drainage ditch is situated at a distance of 79m west of the site. Although this water course would be considered as a fairly sensitive receptor, the only significant contamination identified was a localised slightly elevated concentration of Lead identified within the near surface deposits of made ground in the northern part of the site. No active surface water abstractions have been identified within 2000m of the study site. As the recorded Lead concentrations were only slightly above current ATRISKSoil SSV's and the fact that no traces of Lead contamination were observed within the groundwater underlying the site, it is considered that the risk posed by the site to this surface water receptor is Low.
	Migration of harmful ground gasses / vapours through permeable made ground and natural strata and accumulation in confined spaces.	Construction / Maintenance Workers	No	Low	Low – The Phase 1 Desk Study Report has not identified any significant areas of in-filled ground or historical landfill sites within 250m of the study site that could be considered credible sources of potential harmful ground gas generation such as methane and carbon dioxide. Nevertheless, ground / construction workers should be made aware of the potential risk and employ appropriate safety procedures and PPE especially if they are likely to spend extended periods working within enclosed spaces or within deeper excavations.
		Current and Future Site Users	No	Low	Low – The Phase 1 Desk Study Report has not identified any significant areas of in-filled ground or historical landfill sites within 250m of the study site that could be considered credible sources of harmful ground gas generation such as methane and carbon dioxide. The site is not located in a potential Radon Affected Area as less than 1% of homes, are anticipated to be above the Action Level for homes i.e 200Bqm^{-}). The Groundsure Report indicates that as described in the British Research Establishment publication BR211, in this category, no radon protective measures are necessary for new properties or extensions to existing ones.

8.1 Cover System Design

As the severity of the localised Lead contamination identified in the near surface soil from BH1 was slight, rather than severe, the most feasible remedial strategy would be the provision of a simple cover system of appropriate thickness over the intended rear garden areas of Plots 11 and

12 and also for any exposed areas of soft landscaping **in this part of the site only**. This could be achieved by:-

- Removal of the surface soil / made ground in intended garden / landscaped areas to a depth equivalent to the design thickness of the cover system, and replacing it with the material of the cover system. This option would not result in any increase site surface level following completion of the development.

- The provision of a cover system of appropriate design and thickness placed over the existing ground surface in intended garden / landscaped areas. This option would result in an increase in the site surface level and the implications of this should be considered in the context of the specific nature and setting of the development as a whole.

- A compromise between the above, i.e. removal of a nominal thickness of the surface soil in garden and landscaped areas prior to the placing of the full cover system. Bearing in mind the current environmental pressures on waste disposal sites and the availability of natural replacement materials, economy in design, without compromising safety, is crucial at the present time, in order to limit the impact of remediation on the environment. Consequently if the layout of the development permits, it may be possible to dispose of some of the contaminated material beneath less sensitive areas of the site, i.e. areas of permanent hard cover, thereby reducing the volumes of soil which would otherwise need to be exported to landfill.

The main purpose of a cover system is to reduce the potential long-term exposure to contaminants by end users of the site to acceptable levels. Beneath buildings and any permanent hard standing, an effective barrier between potentially contaminated soil and the end users will exist and therefore in these areas no specific remedial action will be required.

8.2 **Cover System Design Thickness**

The design of a simple cover system should take into consideration the methodology outlined in the BRE Publication 'Cover Systems for Land Regeneration' March 2004. The methodology assumes that intermixing of the cover system with the underlying material will occur over time and provides a means to determine a sufficient thickness of cover (given the nature and severity of the contamination) such that even with complete intermixing in the long-term, the concentrations of contaminants within the mixed zone remain within target guideline values.

Using the contamination test data obtained from BH1 and the procedures outlined in the BRE Publication 'Cover Systems For Land Regeneration' March 2004, it has been determined that the thickness of cover required to mitigate the risk from the recorded Lead contamination should be **252mm** (see enclosed spread sheet). In order to avoid removal from site, any soils deemed to be contaminated by Lead could potentially be reused beneath any less sensitive areas of the proposed development, i.e. beneath areas of permanent hard surfacing. The soil cover should also be of sufficient nutrient status to provide an effective media for healthy plant growth.

The above calculation assumes that the level of contamination in the imported cover materials is well within acceptable guideline values. The BRE publication does not specify materials, which should be used for a cover system other than it should be of 'good quality' and should incorporate a topsoil layer, ideally at least 150mm in thickness or 30% of the cover thickness, whichever is the greater. Reference should be made to Specification for Topsoil BS 3882 2007. Natural soil including sands and gravels and low plasticity clays or mixtures of various soils should be acceptable, provided it has been certified 'clean' at source and has the appropriate documentation. As the covering of topsoil in other parts of the site, was found to be within guideline values for residential garden use, the use of 'site won' topsoil from these areas would be considered acceptable. The provision of a layer of granular material within / at the base of the cover system would serve to act as a capillary break. The existing ground should be suitably compacted prior to placement of the cover system (as set out in CIRIA SP 105). This will inhibit root penetration,

infiltration, burrowing animals and instability but should not be compacted to such an extent that it will induce water logging.

Where soil remediation has been undertaken, a validation report may be required by the regulatory authorities to verify that the works have been completed satisfactorily.

9.0 Precautionary Measures

Some precautionary measures are recommended and these are listed:-

- Ground workers involved in the development should be provided with appropriate personal protective equipment in order to mitigate the risk of temporary exposure to any slight soil contamination on site.

- If materials suspected of being significantly contaminated are revealed during site preparation, then it will be necessary to take representative samples and carry out additional analysis. All such occurrences should be photographed, carefully logged and the extent shown on a copy of the site plan. Remediation work should not take place until this potential 'new' contamination has been fully identified and a remediation strategy approved by the local authority. Any soils suspected of being contaminated, which are stockpiled, should be placed on sheeted areas and representative samples submitted for analysis. Upon receipt of the results, these materials will be either available for re-use or disposed of to an authorized landfill.

- The disposal of any soils from site should be to an appropriate receiving facility. Any documentation relating to the export of soils from site should be retained for possible future inspection by the local authority Environmental Protection Officer. Changes in legislation concerning hazardous waste may have an effect on the disposal costs of any materials from the site.

- The risk to site users, neighbouring occupants, the 'general' public and to construction workers from airborne pollution is considered to be generally 'low'. However, basic dust suppression measures should be adopted for the duration of any earth works as a precaution. Haulage vehicles removing any soils should be provided with a cover to reduce the possibility of release of potentially contaminated airborne particulates during transportation.

- If potable water supply pipes are to be placed within the surface soils, these are likely to necessitate protection. Since elevated concentrations of Lead were identified in the near surface soils in certain parts of the site, the local Water Company should be contacted at an early stage to ascertain their requirements with respect to the materials best suited for the prevailing site conditions. It should be noted that BH1 (where slightly elevated Lead was encountered) is located in the south eastern corner of the site and away from any proposed water main runs from Sproatly Road.

  One of the seven soil samples were submitted for a WIR suite of tests that are commonly used to assist in the materials selection for potable water supply pipes. The results of the test would suggest that PE should be suitable for underground potable water supply.

Provided the measures detailed above in sections 8.0 – 9.0 are implemented then the long term risk to human health and other environmental receptors is considered to be generally Low.

10.0 Engineering Comments Geotechnical

- The recent borings have revealed that the site is overlain by a covering of topsoil and disturbed ground extending to depths of between 0.45m and 0.90m beneath the surface. Over the majority of the site, the underlying natural superficial deposits are initially represented by a sequence of Glacio-fluvial Deposits represented by 'loose' to medium dense silty, fine sand. At depths of between 3.20m to 3.25m beneath the surface, these granular deposits overlie 'soft', brown, laminated, silty clay or 'soft to firm', brown, silty, slightly sandy Boulder Clay. In the north part of the site, the sandy Glacio-fluvial Deposits were found to be largely absent. Here the deposits of topsoil and disturbed ground were underlain by weathered deposits of Glacial Till, predominantly represented by Boulder Clay. This initially comprised deposits of 'firm' mid brown, silty, very sandy clay / clayey sand containing occasional fine assorted gravel. These deposits quickly graded into 'firm' becoming 'stiff', brown, mottled grey, silty, slightly sandy Boulder Clay containing occasional fine fragments of chalk coal and other assorted stones. Once penetrated, the deposits of Boulder Clay subsequently extended to the full depth of borehole penetration. Deposits of Boulder Clay were also encountered in BH4 underlying the Glacio-fluvial sandy deposits at a depth of 3.25m beneath the surface.

- 'Perched' groundwater seepages were experienced whilst penetrating the granular (sandy) Glacio-fluvial deposits at depths of between 1.70m and 2.30m beneath the surface. On completion, groundwater levels in the open borings were measured at depths of between 1.19m and 2.15m beneath the surface. In the northeast corner of the site where the deposits of glacial Boulder Clay were encountered, surface water seepages were observed towards the base of the topsoil or superficial weathered sandy deposits at the interface with the more impermeable deposits of clay beneath. These near surface infiltrations although relatively slow, did begin to drain into and accumulate in the open borings, with levels rising to depths between 0.30m and 1.30m beneath the surface. If these water seepages within the upper topsoil / disturbed ground in the northern part of the site were able to be sealed off, it is likely the boulder clay itself would have remained dry.

- The natural deposits of 'loose' to 'medium dense' silty, fine sand could provide a satisfactory foundation bearing stratum for conventional shallow spread foundations, provided the magnitude of loading does not risk bearing capacity failure and/or excessive settlement. The depth of the foundation excavations will also need to take into consideration the prevailing groundwater conditions existing beneath the various parts of the site. As a preliminary guide to design it has been estimated that for a conventional strip foundation say 600mm wide constructed on undisturbed deposits of 'loose' to 'medium dense', silty sand above the water table (at depths of around 750mm to 900mm b.g.l.), the net allowable foundation bearing pressure would be of the order 100kN/m^2. At this loading, long term settlement should be limited to within 25mm. If looser deposits are identified in the base of foundation excavations, then it would be prudent to consider increasing the width of the foundations to around 800mm to 900mm to help distribute the foundation loading within the weaker materials. If, however, excavations encounter groundwater ingress at very shallow depth, which is a possibility in some areas of the site, then this may require the provision of trench supports and dewatering facilities to enable construction can proceed under optimum conditions. Alternatively it may be more practical to adopt a surface raft solution where these conditions are encountered.

- In the northern corner of the site the Glacio-fluvial deposits of silty sand were absent and the deposits of topsoil and slightly disturbed ground were underlain by deposits of silty, initially very sandy Boulder Clay. These deposits were generally found to be at least 'firm' in consistency, but became stiffer with increasing depth as the deposits became less weathered. Conventional strip foundations which are constructed within Boulder clay with a consistency which is at least 'firm' should have a safe foundation bearing capacity estimated to be in the order of 120kN/m^2. Care should also be exercised whilst forming the foundation excavations in this part of the site particularly if undertaken during periods of wet weather. The presence of impermeable Boulder clay at shallow depth could encourage the accumulation of surface

water which could potentially enter and pour from the near surface into open excavations. This could result in deterioration of the bearing stratum and should be avoided. Additional boreholes (i.e. Boreholes BH9 – BH14) in the northern part of the site were located in an attempt to define as far as possible where the deposits of sand and gravel are essentially absent and the Boulder Clay is present close to the surface. The available borehole information appears to indicate that the proposed dwellings on Plots 23 and 24 are likely to be underlain by deposits of Boulder Clay close to the surface. It is also considered possible that Boulder Clay could be present at shallow depth beneath the northern corner of Plot 22.

- Atterberg limit determinations have revealed that the deposits of Glacial Boulder Clay are of medium shrinkage / swell potential and as such these soils would be susceptible to volume change associated with seasonal fluctuations in soil moisture content which could be exacerbated by tree root action. The design of foundations constructed within the areas of Boulder Clay may, therefore, need to take into consideration the proximity of any existing trees/hedges or those which have been recently removed or any new plantings to any intended new structures. In this regard the NHBC Standard Chapter 4.2 'Building near Trees' provides useful guidance on building near trees particularly in shrinkable clayey soils. This is only likely to affect the dwellings proposed on Plots 22, 23 and 24. If we consider the detached property proposed on Plot 24, at its closest point this will come within approximately 2.4m from a line of trees to the west including Norwegian Maple (16m-18m), which have recently been removed. Using NHBC Chapter 4.2 Appendix 4.2C Chart 2 for soils with a medium shrinkage / swell potential, the derived foundation depth to accommodate the presence of the recently removed trees would be approximately 1.70m (including adjustments for climatic variations). At this depth the deposits of glacial Boulder Clay are somewhat stiffer, therefore a foundation bearing pressure of approximately 160kN/m^2 could be accommodated at this depth. Neither the main property, nor the integrated garage on the eastern elevation of this property will lie within influencing distance of a nearby Hawthorn Hedge which has recently been reduced in height from approximately 4m to 1.5m in height.

  Considering the detached property proposed for Plot 23, the eastern corner of this property will be located approximately 3.3m away from the centreline of the adjacent Hawthorn hedge (which is possibly scheduled to be removed having been reduced from its original height of 4m to now approximately 1.5m). Using NHBC Chapter 4.2 Appendix 4.2C Chart 2 for soils with a medium shrinkage / swell potential, the derived foundation depth to accommodate the presence of the Hawthorn hedgerow (assuming it is to be removed at a maximum height of 4m) would be 1.45m (including adjustments for climatic variations). On Plots 23 and 24, as the distance of the foundations from the trees / hedgerow increases, the depth of the foundations could be reduced in line with the recommendations of Chart 2. As a preliminary guide, on Plot 23, foundation depths would return to a standard depth of 0.90m at a distance of approximately 5m from the Hawthorn Hedgerow.

- The shared detached garage structure for Plots 22 and 23, is also located within influencing distance of the mature Hawthorn hedgerow which extends along the eastern site boundary. If the use of deep trench fill foundations is considered to be uneconomical or impractical for the garage, consideration could be given to employing a near surface reinforced raft construction. Although some risk of differential settlement could occur due to the continued cyclic dehydration and rehydration of the near surface soils due to the presence of the Hawthorn, a suitably reinforced raft should, by virtue of it inherent stiffness and load spreading capability be capable of accommodating potential soil movements. In order to mitigate the potential influence of the Hawthorn hedgerow a greater than normal thickness of stone infill may be required beneath the eastern corner of the garage. This is usually calculated as 50% of the derived foundation depth which in this case equates to approximately 1100mm of stone infill.

- Although the covering of topsoil was relatively shallow this was occasionally underlain by deposits of slightly disturbed silty and clayey sand. These deposits were found to be relatively 'soft', or 'loose' therefore the use of ground bearing floor slabs is not recommended for the intended dwellings. Instead a fully suspended ground floor construction would be preferable, as this would eliminate the potential for differential settlement which could occur should 'soft

spots' be present within the underlying sub-grade. The use of a suspended ground floor slab would also mitigate the potential effects of potential soil movements particularly beneath those dwellings constructed over clay soils located within influencing distance of trees or other significant vegetation.

- In order to assist with the design of roads and paved areas, CBR tests were performed at four locations in accordance with the method TRL 587 CBR Tests DCP (Dynamic Cone Penetration). The results of the tests have been provided on the accompanying spreadsheets and graphs. At an anticipated formation level of approximately 0.20m to 0.30m beneath the existing surface, approximate CBR values (to the nearest 1%) ranged between 3% and 7%. This being the case, it may be prudent to adopt the lower value of 3% for preliminary design purposes as the compaction of the near surface deposits may vary somewhat across the general area of the site.

- Results of the recent borehole soakage (soakaway) trials indicate that the predominantly granular deposits of silty, fine sand which are present beneath the surface over the majority of the site (southern bulk of site) are quite permeable. The results of the soakage tests performed in a number of the completed boreholes recorded soil infiltration rates varying between 2.72 x 10^{-3}mm/s and 4.19 x 10^{-2}mm/s. It is noted that 'perched' groundwater infiltrations were encountered at depths of between 1.20m and 2.30m beneath the surface and on penetration water levels rose to depths of between 1.53m and 1.20m beneath the surface. In certain parts of the site, the shallow 'perched' groundwater level will restrict the effective storage capacity somewhat. This being the case, the use of shallower, longer 'trench style' soakaways could provide a more practical alternative to conventional, deeper chamber type soakaways. In northern most areas of the site where Boulder Clay was encountered directly beneath the near surface topsoil, the use of soakaways will not be feasible.

- Chemical tests performed on representative samples of the near surface soils and made / disturbed ground as part of the environmental screening, recorded water-soluble sulphate concentrations between 10mg/l and 70mg/l (2:1water / soil extract) with pH between 6.6 and 7.3. Tests performed on the samples of 'perched' groundwater recorded sulphate concentrations of 48mg/l and 63mg/l with pH values of 8.5. These values fall within design sulphate classes DS-1 of the BRE Digest Special Digest 1 classification 'Concrete in Aggressive Ground'. In accordance with the guidelines contained in Part 1 of the Digest and taking into account the geology and specific soil and groundwater conditions, the site can be assigned an ACEC (Aggressive Chemical Environment for Concrete) Class AC-1.

The opinions expressed in this Report are consistent with guideline standards available at the time of its preparation and assume that the ground conditions do not vary significantly beyond the range revealed within the agreed scope and budget for the investigation. There may, however, be conditions at the site, which have not been identified by the investigation and therefore will not have been considered in the report. Accordingly a careful watch should be maintained during any future ground works at the site and the report and its conclusions reviewed and / or modified accordingly within the context of the nature any development intended at the site.

Prepared by: …… ……**R. L. Trattles** (Director)

Reviewed by: …… ……**S. P. Trattles** (Director)

TLP Ground Investigation Ltd. RT/WHY/SA/SRP/01/21

Site Location Plan

Proposed Residential Development, Sproatley Road, Preston, East Yorkshire

Site Location Plan

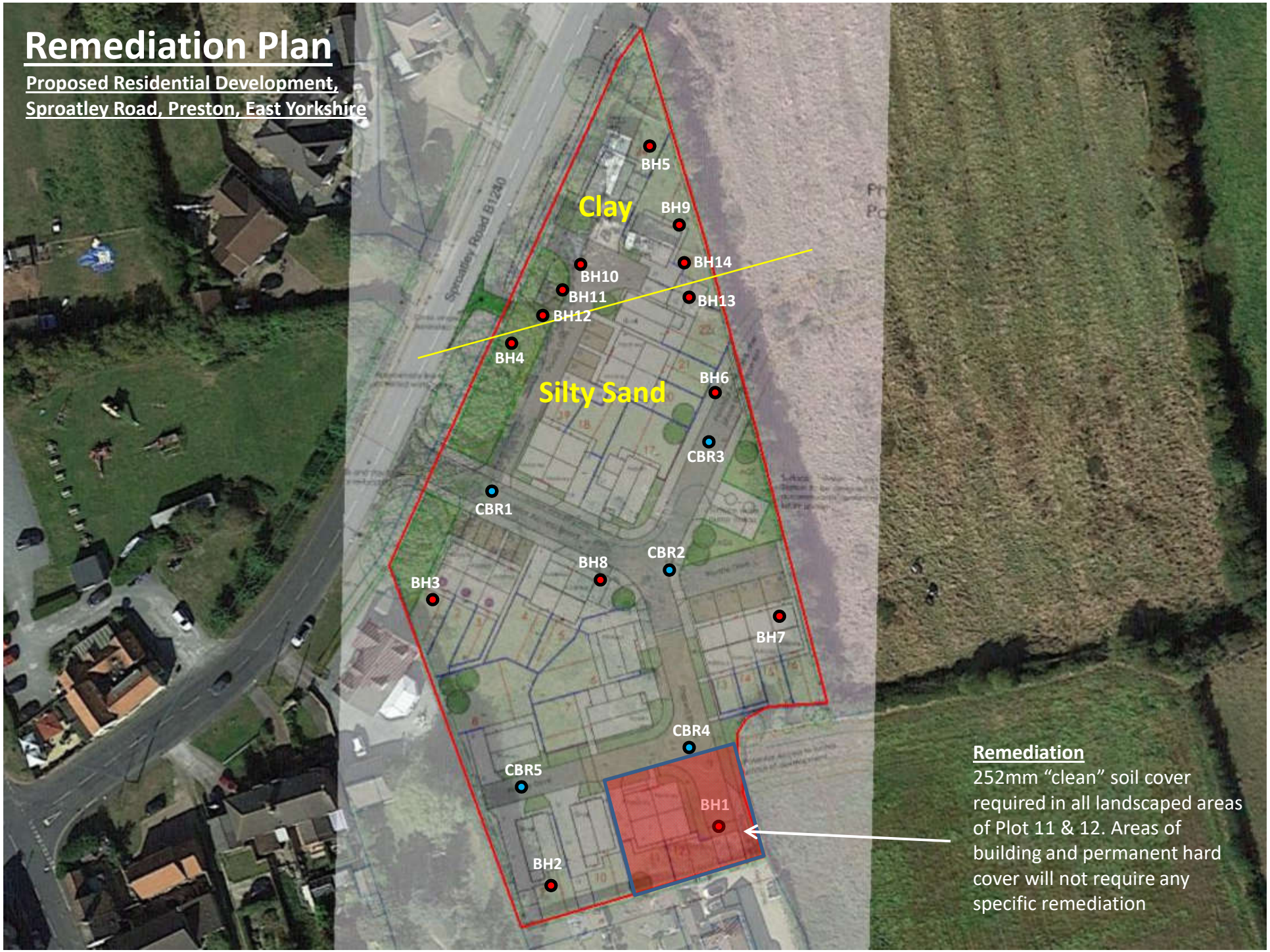
Proposed Residential Development, Sproatley Road, Preston, East Yorkshire

Borehole Location Plan

Proposed Residential Development,
Sproatley Road, Preston, East Yorkshire

Borehole Location Plan

Proposed Residential Development,
Sproatley Road, Preston, East Yorkshire


Remediation Plan
Proposed Residential Development,
Sproatley Road, Preston, East Yorkshire
Sproatley Road B1240
Clay
Silty Sand
BH5
BH9
BH14
BH10
BH11
BH13
BH12
BH4
BH6
CBR3
CBR1
CBR2
BH8
BH3
BH7
CBR4
CBR5
BH1
BH2
Remediation
252mm "clean" soil cover required in all landscaped areas of Plot 11 & 12. Areas of building and permanent hard cover will not require any specific remediation

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH1.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 04.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Mid brown, silty, sandy, slightly clayey **Topsoil** containing occasional fine fragments of brick and coal.			(0.30) 0.30	0.00 - 1.10	U	1		
Topsoil / Disturbed Ground								
Loose, mid brown, silty, slightly clayey and sandy soil containing occasional fine to medium fragments of brick and coal.			(0.60) 0.90					
Loose, rust brown, silty, medium **Sand.**			(0.60) 1.50	1.10 - 2.10	U	2	S N5	
Glaciofluvial Deposits								
Medium dense becoming loose, mid brown, very silty, fine **Sand** / sandy **Silt.**				2.10 - 3.10	U	3	S N10	
				3.10	D	1	S N6	
			3.55					
End of Borehole								

Observations

Groundwater seepages were encountered at around 2.00m beneath the surface. On completion groundwater level measured at 1.48m beneath the surface.

In order to establish the relative permeability of the near surface stratum in situ, a 'falling head' / (variable head) permeability test was performed in the completed borehole. The results of the test are presented on the enclosed data sheets.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH2.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 04.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Very loose, mid brown, silty, sandy, slightly clayey **Topsoil** containing occasional fine stone fragments.			(0.25)	0.00 - 1.10	U	1	S N2	
Topsoil / Disturbed Ground			0.25					
Very loose, mid brown, silty, slightly clayey and sandy soil containing occasional fine stone fragments.			(0.20) 0.45					
Loose, mid brown and rust brown, silty, medium **Sand** containing occasional fine gravel**.**			(0.65)					
Glaciofluvial Deposits			1.10	1.10 - 2.10	U	2	S N7	
Loose, mid brown, very silty, fine **Sand**.			(2.10)	2.10 - 3.10	U	3	S N5	
				3.10	D	1	S N5	
Firm, mid brown, partly laminated, silty **Clay** interspersed with partings of brown silt.			3.20					
			3.55					
			End of Borehole					

Observations

Groundwater seepages were encountered at around 2.00m beneath the surface. On completion groundwater measured at 1.43m beneath the surface.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH3.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 04.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Medium dense, mid brown, silty, sandy, slightly clayey **Topsoil** containing occasional fine stone fragments.			(0.27)	0.00 - 1.10	U	1	S N11	
Topsoil / Disturbed Ground			0.27					
Medium dense, mid brown, silty, very sandy, slightly clayey soil containing very occasional fine fragments of stone.			(0.33)					
			0.60					
Loose, mid brown and rust brown, silty, slightly clayey, medium **Sand.**			(0.60)					
				1.10 - 2.10	U	2	S N4	
			1.20	1.25			Vane	37kN/m²
Soft or soft to firm, mid brown, mottled rust brown, very silty, slightly clayey **Sand**.			(0.37)					
				1.50			Vane	44kN/m²
			1.57					
Glaciofluvial Deposits								
				2.10 - 3.10	U	3	S N19	
Medium dense, mid brown, very silty, fine **Sand** containing occasional fine gravel.								
				3.10	D	1	S N26	
			3.55					
			End of Borehole					

Observations

Groundwater seepages were encountered at around 1.60m beneath the surface. On completion groundwater measured at 1.19m beneath the surface.

In order to establish the relative permeability of the near surface soils in situ, a 'falling head' (variable head) permeability test was performed in the completed borehole. The results of the tests are presented on the enclosed data sheets.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH4.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 04.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Very loose, mid brown, silty, sandy, slightly clayey **Topsoil** containing occasional fine stone fragments.				0.00 - 1.10	U	1		
			(0.30)					
Topsoil / Disturbed Ground			0.30					
			(0.20)					
Loose, dark brown, silty, sandy soil containing occasional fine fragments of coal.			0.50					
Loose, mid brown and rust brown, silty, slightly clayey, medium **Sand.**			(1.10)	1.10 - 2.10	U	2	S N6	
Glaciofluvial Deposits			1.60					
Firm, mid brown, partly laminated, silty **Clay** interspersed with partings of brown silt.			(0.60)					
			2.20	2.10 - 3.10	U	3	S N14	
Medium dense, mid brown **Silt.**.			(0.40)					
			2.60					
Medium dense, mid brown, silty, fine **Sand** containing assorted fine chalk **Gravel.**			(0.65)					
				3.10	D	1	S N8	
Soft to firm, rust brown, silty, slightly sandy **Clay** containing occasional fine fragments of chalk and other assorted gravel.			3.25					
Glacial Till (Boulder Clay)			3.55					
			End of Borehole					

Observations

Groundwater seepages were encountered at around 1.70m beneath the surface. On completion groundwater measured at 1.33m beneath the surface.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH5.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 04.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Loose, dark brown, silty, sandy **Topsoil** containing occasional fine stone fragments.			(0.30)	0.00 - 1.10	U	1		
Topsoil / Disturbed Ground			0.30					
Loose, dark brown, silty, sandy, clayey soil containing occasional fine fragments of stone.			(0.40)					
Soft, mid brown, mottled rust brown, very silty, slightly sandy **Clay** containing occasional fine to medium fragments of chalk and other assorted gravel.			0.70 (0.30)	0.80			Vane	40kN/m²
			1.00	1.10 - 2.10	U	2	Vane	58kN/m²
Glacial Till				1.40			Vane	82kN/m²
Firm becoming stiff, brown, mottled grey, silty, slightly sandy **Clay** containing occasional fine fragments of chalk, coal and other assorted gravel.				1.70			Vane	81kN/m²
				2.00			Vane	84kN/m²
				2.10 - 3.10	U	3		
				2.30			Vane	110kN/m²
				2.60			Vane	112kN/m²
				2.90			Vane	75kN/m²
			3.10					
			End of Borehole					

Observations

Although no significant water seepages were encountered within the depth penetrated, surface water seepages began entering the borehole on completion.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH6.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 04.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Medium dense, mid brown, silty, sandy, slightly clayey **Topsoil** containing occasional fine stone fragments..			(0.35)	0.00 - 1.10	U	1		
Topsoil			0.35					
Medium dense, brown and rust brown, silty **Sand** containing assorted fine gravel.			(0.42)					
			0.77					
Loose, brown, mottled rust brown, silty, slightly clayey **Sand.**			(0.93)	1.10 - 2.10	U	2	S N6	
Glaciofluvial Deposits			1.70					
Medium dense, mid brown and rust brown, very silty, fine **Sand** / sandy **Silt**.				2.10 - 3.10	U	3	S N11	
				3.10	D	1	S N10	
			3.55					
			End of Borehole					

Observations

Groundwater seepages were encountered at around 1.70m beneath the surface. On completion groundwater level measured at 1.64m beneath the surface.

In order to establish the relative permeability of the near surface soils in situ, a 'falling head' (variable head) permeability test was performed in the completed borehole. The results of the tests are presented on the enclosed data sheets.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH7.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 04.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Dark brown, silty and sandy **Topsoil** containing occasional fine fragments of clay pipe.				0.00 - 1.10	U	1		
			(0.35)					
Topsoil / Disturbed Ground			0.35					
Medium dense, brown and rust brown, silty, sandy soil containing occasional fine gravel.			(0.43)					
			0.78					
Loose, light brown, mottled rust brown, silty, fine **Sand.**			(0.72)	1.10 - 2.10	U	2	S N8	
Glaciofluvial Deposits			1.50					
Very loose, rust brown, partly laminated, very silty, fine **Sand** / sandy **Silt.**			(0.80)					
			2.30	2.10 - 3.10	U	3	S N3	
Soft to firm becoming firm, brown, partly laminated, silty **Clay** interspersed with partings of brown silt.				2.50			Vane	45kN/m²
				2.80			Vane	55kN/m²
				3.10	D	1	S N11	
			3.55					
			End of Borehole					

Observations

Groundwater seepages were encountered at around 2.30m beneath the surface. On completion groundwater measured at 2.15m beneath the surface.

In order to establish the relative permeability of the near surface soils in situ, a 'falling head' (variable head) permeability test was performed in the completed borehole. The results of the tests are presented on the enclosed data sheets.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH8.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 04.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Dark brown, silty and sandy **Topsoil** containing occasional fine stone fragments.			(0.30)	0.00 - 1.10	U	1		
Topsoil / Disturbed Ground			0.30					
Medium dense, brown and dark brown, silty, sandy soil containing occasional fine gravel.			(0.20) 0.50					
Loose, rust brown, silty, medium **Sand.**			(0.80)					
Glaciofluvial Deposits				1.10 - 2.10	U	2	S N5	
			1.30					
Very loose, rust brown, partly laminated, very silty, fine **Sand** / sandy **Silt.**				2.10	D	1	S N2	
			2.55					
			End of Borehole					

Observations

Groundwater seepages were encountered at around 1.70m beneath the surface. On completion groundwater measured at 1.68m beneath the surface.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH9.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 16.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Dark brown, silty and sandy **Topsoil** containing occasional fine stone fragments.			(0.30)	0.00 - 1.10	U	1		
Topsoil / Disturbed Ground			0.30					
Firm, mid brown, silty, very sandy **Clay** containing occasional fine gravel.			(0.45)	0.50			Vane	58kN/m²
			0.75	0.80			Vane	80kN/m²
Glacial Till (Boulder Clay)				1.10 - 2.10	U	2	Vane	55kN/m²
Firm to stiff becoming stiff, brown, mottled grey, silty, slightly sandy **Clay** containing occasional fine fragments of chalk, coal and other assorted gravel.				1.40			Vane	88kN/m²
				1.70			Vane	88kN/m²
				2.00			Vane	110kN/m²
			2.10					
End of Borehole								

Observations

Perched water seepages were encountered at around 0.30m beneath the surface at the base of the topsoil. No significant seepages were encountered within the deposits of Glacial Till. On completion, water entering the borehole from the surface began to accumulate in the base of the hole.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH10.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 16.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Dark brown, silty and sandy **Topsoil** containing occasional fine fragments of stone.			(0.30)	0.00 - 1.10	U	1		
Topsoil / Disturbed Ground			0.30					
Mid brown, silty, slightly clayey **Sand.**			(0.15)					
Damp, mid brown, silty **Sand.**			0.55					
			(0.25)					
Glacial Till			0.80	0.90			Vane	88kN/m²
Firm to stiff becoming stiff, brown, mottled grey, silty, slightly sandy **Clay** containing occasional fine fragments of chalk, coal and other assorted stones.				1.10 - 2.10	U	2	Vane	97kN/m²
				1.40			Vane	110kN/m²
Glacial Till (Boulder Clay)				1.70			Vane	122kN/m²
				2.00			Vane	124kN/m²
Observations			2.10					
Perched water seepages were encountered at around 0.30m beneath the surface at the base of the topsoil layer. No significant seepages were encountered within the deposits of Glacial Till. On completion, water from the base of the topsoil layer began to accumulate in the base of the hole.		**End of Borehole**						

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH11.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 16.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Dark brown, silty and sandy **Topsoil** containing occasional fine stone fragments.			(0.32)	0.00 - 1.10	U	1		
Topsoil / Disturbed Ground			0.32					
Mid brown, silty, slightly clayey **Sand** containing occasional fine gravel**.**			(0.38)					
			0.70					
				0.80			Vane	42kN/m²
Glacial Till								
				1.10 - 2.10	U	2	Vane	22kN/m²
Soft to firm becoming firm to stiff, brown, mottled grey, silty, very sandy **Clay** containing occasional fine fragments of chalk, coal and other assorted stones.				1.40			Vane	74kN/m²
Glacial Till (Boulder Clay)				1.70			Vane	87kN/m²
				2.00			Vane	94kN/m²
Observations			2.10					
Perched water seepages were encountered at around 0.70m beneath the surface. No significant seepages were encountered within the deposits of Glacial Till. On completion water began to slowly accumulate in the base of the borehole.			**End of Borehole**					

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH12.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 16.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Dark brown, silty and sandy **Topsoil** containing occasional fine fragments of stone.			(0.35)	0.00 - 1.10	U	1		
Topsoil / Disturbed Ground			0.35					
Mid brown, silty, slightly clayey **Sand** containing occasional fine stones**.**			(0.45)					
Glacial Till			0.80					
Soft becoming firm, brown, mottled grey, silty, very sandy **Clay** containing occasional fine gravel.				0.90			Vane	30kN/m²
				1.10 - 2.10	U	2	Vane	110kN/m²
Glacial Till (Boulder Clay)			(0.95)	1.40			Vane	68kN/m²
Damp to wet, mid brown, silty, slightly clayey **Sand.**			1.75	1.70			Vane	50kN/m²
			2.10					
			End of Borehole					

Observations

Perched water seepages were encountered at around 1.75m beneath the surface. On completion groundwater level measured at 1.25m beneath the surface.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH13.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 16.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Dark brown, silty and sandy **Topsoil** containing occasional fine stone fragments.				0.00 - 1.10	U	1		
			(0.30)					
Topsoil / Disturbed Ground			0.30					
Soft, mid brown, silty, sandy and clayey soil containing occasional fine fragments of brick and stone.			(0.22)					
			0.52	0.50			Vane	33kN/m²
Soft, buff brown and occasionally dark brown, silty, sandy and clayey soil.			(0.58)	0.80			Vane	33kN/m²
			1.10	1.10 - 2.10	U	2		
Loose, buff brown and grey, silty, fine to medium **Sand.**			(0.30)					
			1.40					
Glaciofluvial Deposits								
Loose, mid brown and rust brown, silty, fine to medium **Sand** containing assorted fine chalk gravel**.**								
			2.10					
			End of Borehole					

Observations

Perched water seepages were encountered at around 1.35m beneath the surface. On completion groundwater level measured at 1.30m beneath the surface.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

Fig.

T.L.P. Ground Investigations Ltd.	**Borehole Record** Dynamic Sampling Rig	**Location :** Residential Development, Sproatley Road, Preston, East Yorkshire.	**Borehole No.** BH14.
Carried out For Ward Homes Yorkshire.		Ground Level	Co-ordinates	Date : 16.12.20.

Description	Reduced Level	Legend	Depth & Thickness	Samples/Tests: Depth	samples: Type	samples: No.	Test	Field Records
Dark brown, silty and sandy **Topsoil** containing occasional fine fragments of stone.			(0.30)	0.00 - 1.10	U	1		
Topsoil / Disturbed Ground			0.30					
Mid brown, silty, slightly clayey **Sand** containing occasional fine stones**.**			(0.40)					
Firm, brown, mottled grey, silty, slightly sandy **Clay** containing occasional fine fragments of chalk, coal and other assorted stones.			0.70 (0.30)	0.80			Vane	72kN/m²
Damp, soft, mid brown, mottled grey silty, slightly clayey **Sand.**			1.00 (0.35)	1.10 - 2.10	U	2	Vane	22kN/m²
Glacial Till			1.35	1.40			Vane	66kN/m²
Firm becoming stiff, brown, mottled grey, silty, slightly sandy **Clay** containing occasional fine fragments of chalk, coal and other assorted stones.				1.70			Vane	85kN/m²
				2.00			Vane	100kN/m²
			2.10					
			End of Borehole					

Observations

Slight 'perched' groundwater seepages were encountered at around 1.20m beneath the surface. On completion groundwater level measured at 1.20m beneath the surface.

S.P.T. : Where full penetration has not been achieved the number of blows for the quoted penetration is given (Not 'N' value)

Depths: All depths and reduce levels in metres. Thickness given in brackets in depth column.

Samples/Test Key.

D Disturbed Sample
B Bulk Sample
W Water Sample
U Undisturbed Core sample
S Standard Penetration Test
V Vane Test

Remarks

Logged by S. P. T. / J. T.

Scale 1 : 25

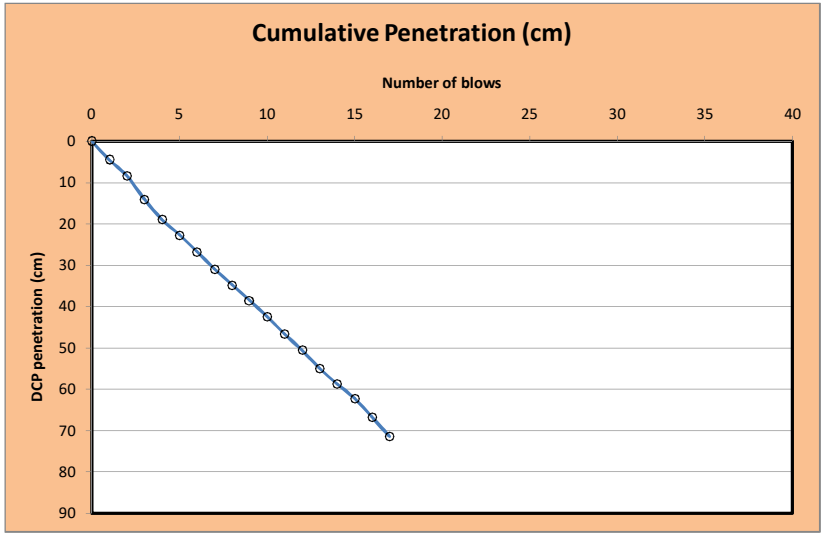
Fig.

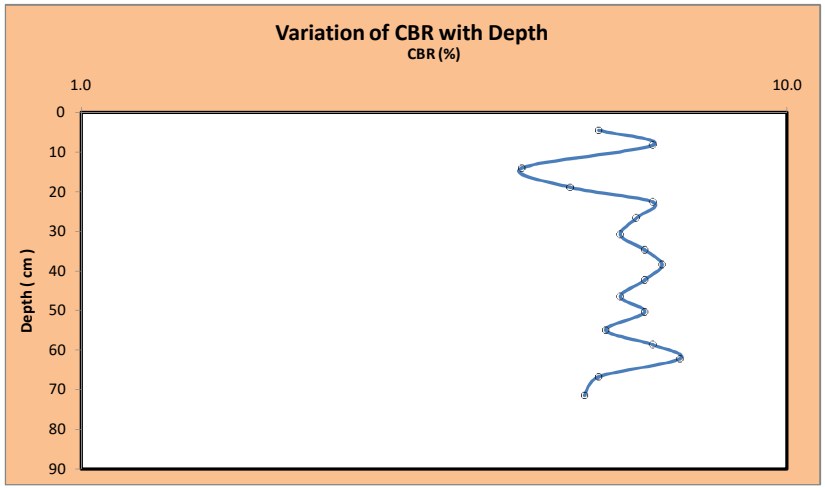
TRL 587 CBR Analysis

Site	Sproatley Road, Preston
Sample Location	CBR1
Date of Test	04/12/2020

ANALYSIS OF DYNAMIC CONE PENETRATION TEST RESULT

No. of Blows	DCP Scale Reading (cm)	Penetration /Blow (mm)	Cumulative Penetration (mm)	CBR Value (%)	Cumulative Penetration (cm)	
0	11.3	0	0		0	
1	15.8	45	45	5.4	4.5	
2	19.6	38	83	6.5	8.3	anticipated formation
3	25.3	57	140	4.2	14	
4	30.2	49	189	4.9	18.9	
5	34	38	227	6.5	22.7	
6	38	40	267	6.1	26.7	
7	42.2	42	309	5.8	30.9	
8	46.1	39	348	6.3	34.8	
9	49.8	37	385	6.6	38.5	
10	53.7	39	424	6.3	42.4	
11	57.9	42	466	5.8	46.6	
12	61.8	39	505	6.3	50.5	
13	66.2	44	549	5.5	54.9	
14	70	38	587	6.5	58.7	
15	73.5	35	622	7.0	62.2	
16	78	45	667	5.4	66.7	
17	82.7	47	714	5.2	71.4	



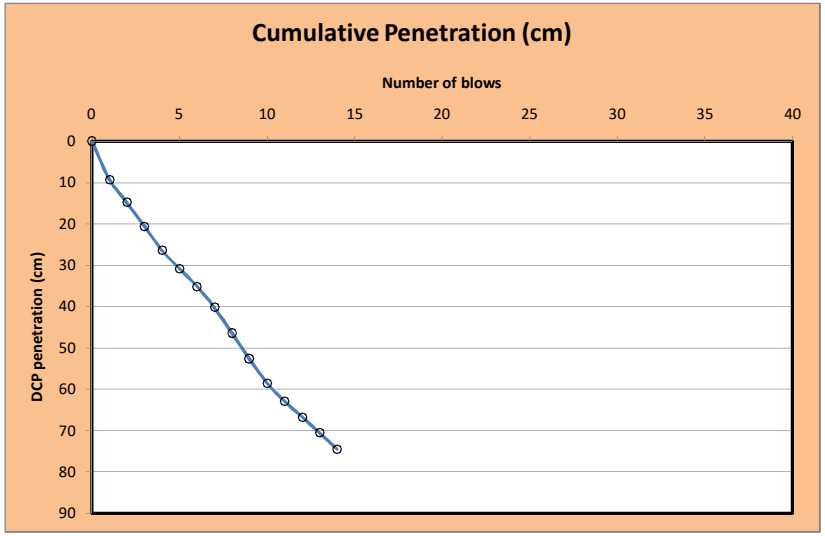


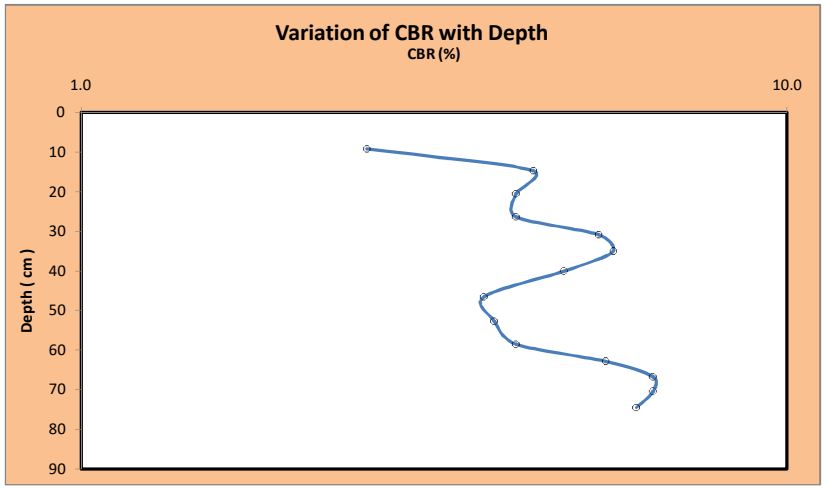
TRL 587 CBR Analysis

Site	Sproatley Road, Preston
Sample Location	CBR2
Date of Test	04/12/2020

ANALYSIS OF DYNAMIC CONE PENETRATION TEST RESULT

No. of Blows	DCP Scale Reading (cm)	Penetration /Blow (mm)	Cumulative Penetration (mm)	CBR Value (%)	Cumulative Penetration (cm)	
0	6.5	0	0		0	
1	15.7	92	92	2.5	9.2	
2	21.2	55	147	4.4	14.7	anticipated formation
3	27	58	205	4.1	20.5	
4	32.8	58	263	4.1	26.3	
5	37.3	45	308	5.4	30.8	
6	41.6	43	351	5.7	35.1	
7	46.6	50	401	4.8	40.1	
8	53	64	465	3.7	46.5	
9	59.2	62	527	3.8	52.7	
10	65	58	585	4.1	58.5	
11	69.4	44	629	5.5	62.9	
12	73.2	38	667	6.5	66.7	
13	77	38	705	6.5	70.5	
14	81	40	745	6.1	74.5	





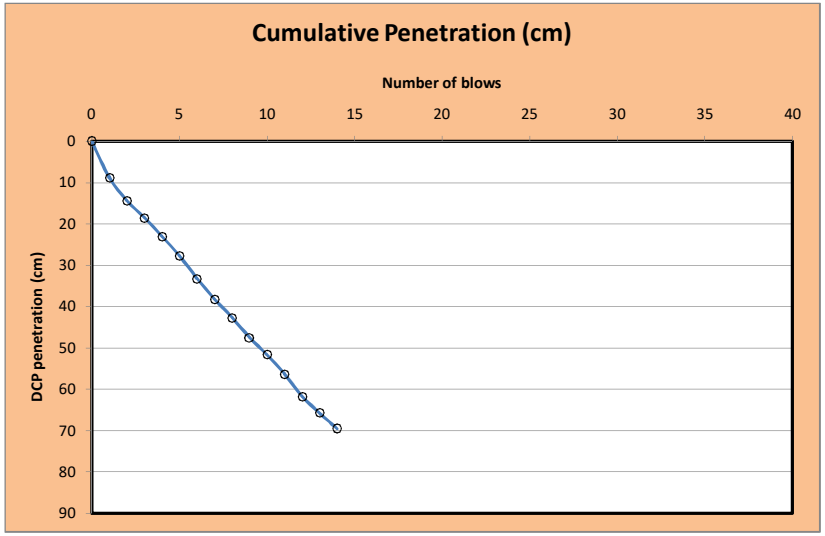
TRL 587 CBR Analysis

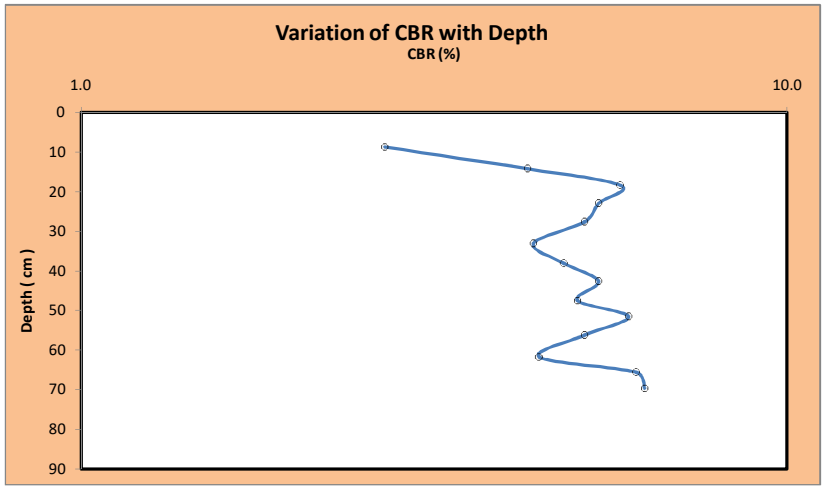
Site	Sproatley Road, Preston
Sample Location	CBR3
Date of Test	04/12/2020

ANALYSIS OF DYNAMIC CONE PENETRATION TEST RESULT

No. of Blows	DCP Scale Reading (cm)	Penetration /Blow (mm)	Cumulative Penetration (mm)	CBR Value (%)	Cumulative Penetration (cm)
0	13.5	0	0		0
1	22.2	87	87	2.7	8.7
2	27.8	56	143	4.3	14.3
3	32	42	185	5.8	18.5
4	36.5	45	230	5.4	23
5	41.2	47	277	5.2	27.7
6	46.7	55	332	4.4	33.2
7	51.7	50	382	4.8	38.2
8	56.2	45	427	5.4	42.7
9	61	48	475	5.0	47.5
10	65.1	41	516	6.0	51.6
11	69.8	47	563	5.2	56.3
12	75.2	54	617	4.5	61.7
13	79.2	40	657	6.1	65.7
14	83.1	39	696	6.3	69.6

anticipated formation



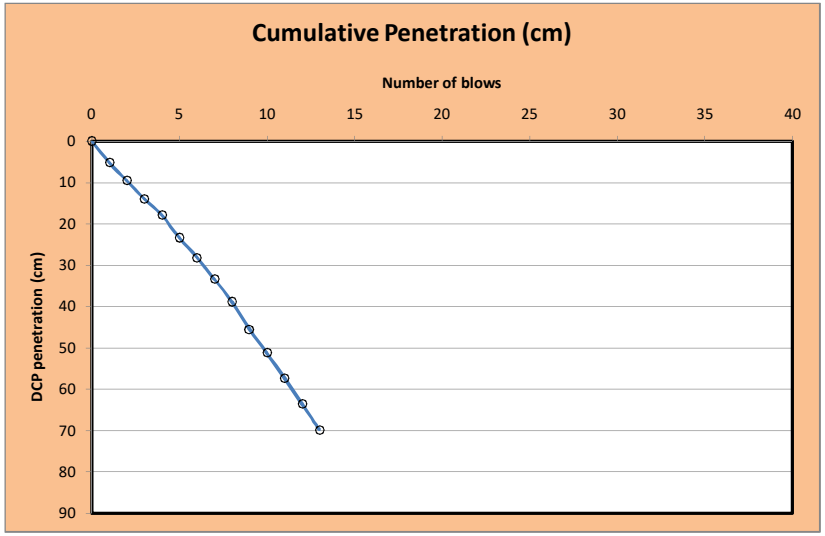


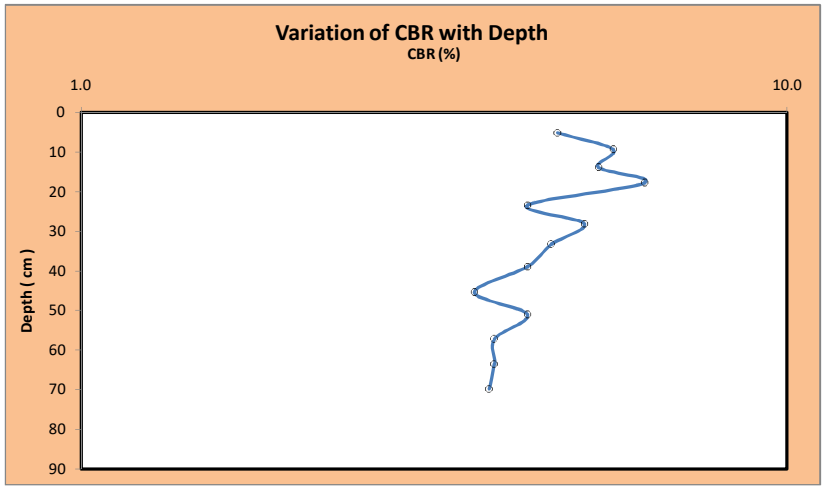
TRL 587 CBR Analysis

Site	Sproatley Road, Preston
Sample Location	CBR4
Date of Test	04/12/2020

ANALYSIS OF DYNAMIC CONE PENETRATION TEST RESULT

No. of Blows	DCP Scale Reading (cm)	Penetration /Blow (mm)	Cumulative Penetration (mm)	CBR Value (%)	Cumulative Penetration (cm)	
0	11.9	0	0		0	
1	17	51	51	4.7	5.1	
2	21.3	43	94	5.7	9.4	anticipated formation
3	25.8	45	139	5.4	13.9	
4	29.7	39	178	6.3	17.8	
5	35.3	56	234	4.3	23.4	
6	40	47	281	5.2	28.1	
7	45.2	52	333	4.6	33.3	
8	50.8	56	389	4.3	38.9	
9	57.4	66	455	3.6	45.5	
10	63	56	511	4.3	51.1	
11	69.2	62	573	3.8	57.3	
12	75.4	62	635	3.8	63.5	
13	81.7	63	698	3.8	69.8	



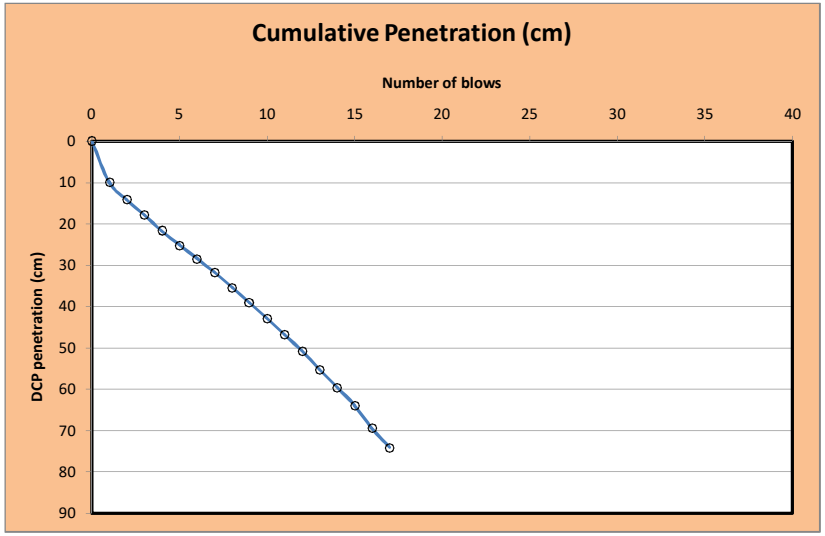


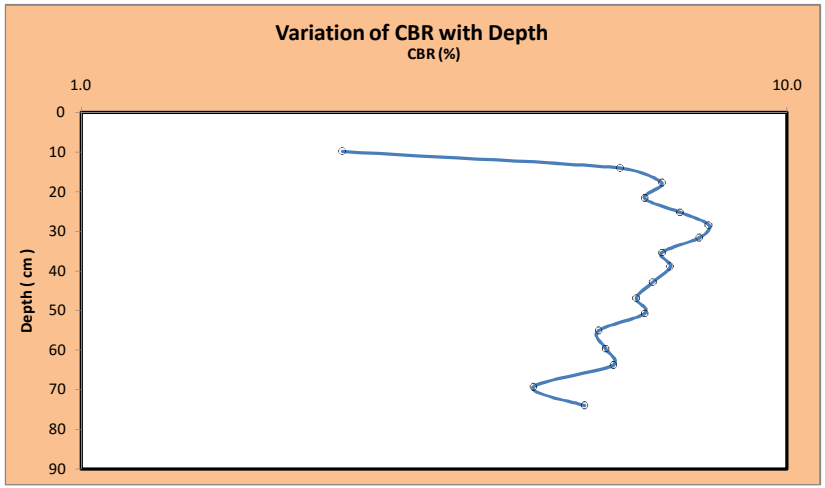
TRL 587 CBR Analysis

Site	Sproatley Road, Preston
Sample Location	CBR5
Date of Test	04/12/2020

ANALYSIS OF DYNAMIC CONE PENETRATION TEST RESULT

No. of Blows	DCP Scale Reading (cm)	Penetration /Blow (mm)	Cumulative Penetration (mm)	CBR Value (%)	Cumulative Penetration (cm)	
0	8.2	0	0		0	
1	18.1	99	99	2.3	9.9	
2	22.3	42	141	5.8	14.1	anticipated formation
3	26	37	178	6.6	17.8	
4	29.9	39	217	6.3	21.7	
5	33.4	35	252	7.0	25.2	
6	36.6	32	284	7.7	28.4	
7	39.9	33	317	7.5	31.7	
8	43.6	37	354	6.6	35.4	
9	47.2	36	390	6.8	39	
10	51	38	428	6.5	42.8	
11	55	40	468	6.1	46.8	
12	58.9	39	507	6.3	50.7	
13	63.4	45	552	5.4	55.2	
14	67.8	44	596	5.5	59.6	
15	72.1	43	639	5.7	63.9	
16	77.6	55	694	4.4	69.4	
17	82.3	47	741	5.2	74.1	



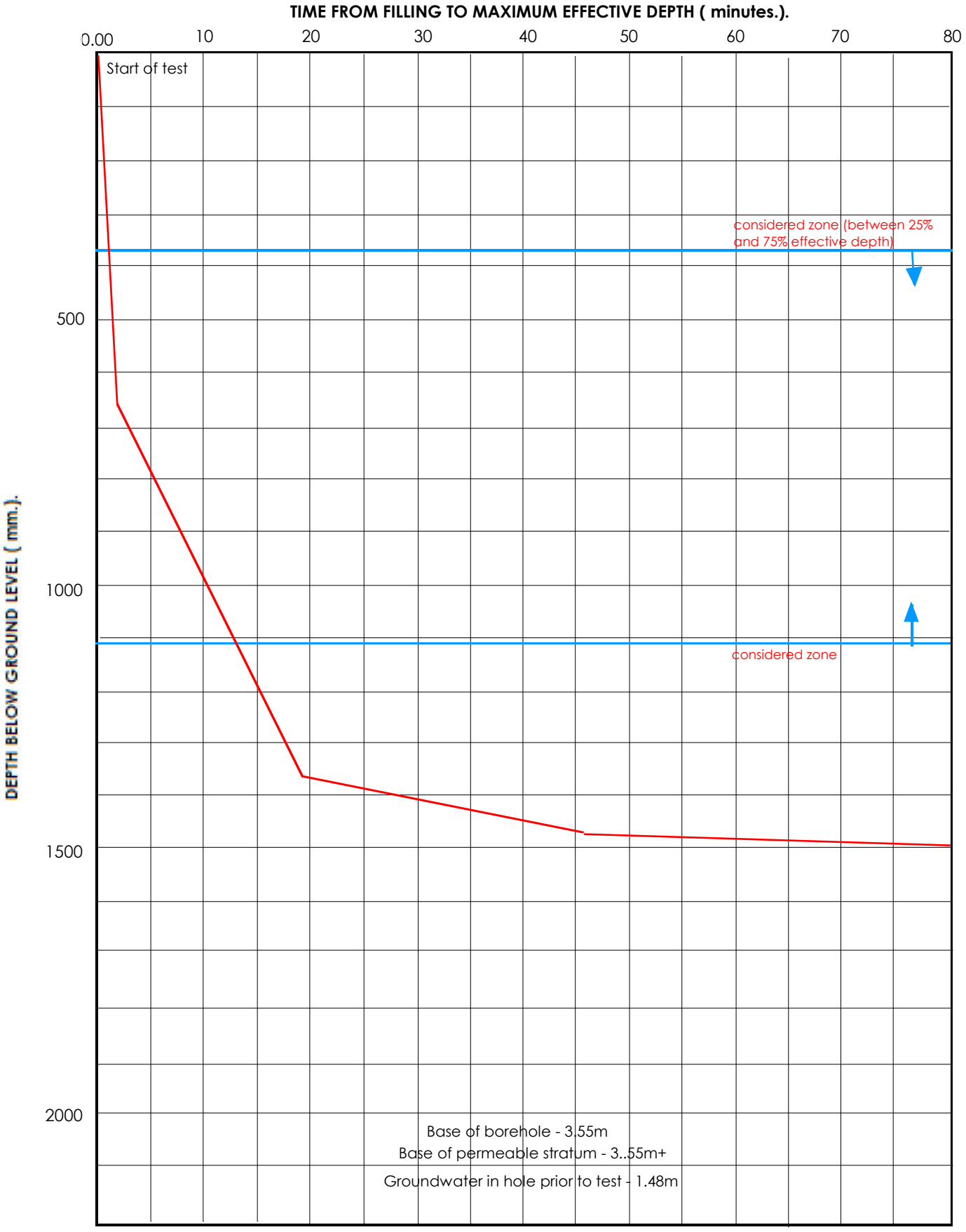


Percolation Graph

Falling Head Test

Soak BH1

Project Location : **Sproatley Road, Preston.**
Client : **Ward Homes**
Date of SI : **04.12.2020**

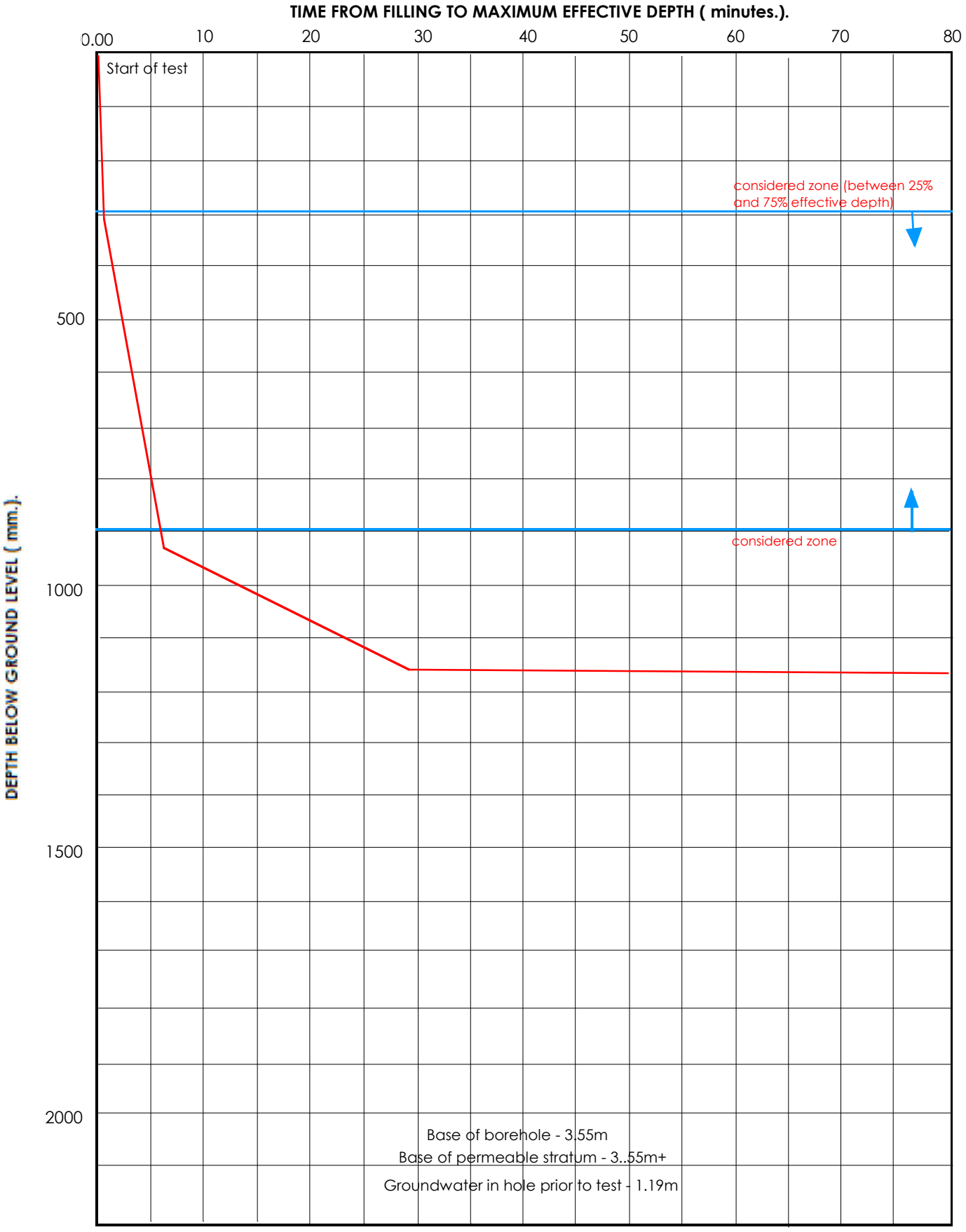


Percolation Graph

Falling Head Test

Soak BH3

Project Location : **Sproatley Road, Preston.**
Client : **Ward Homes**
Date of SI : **04.12.2020**

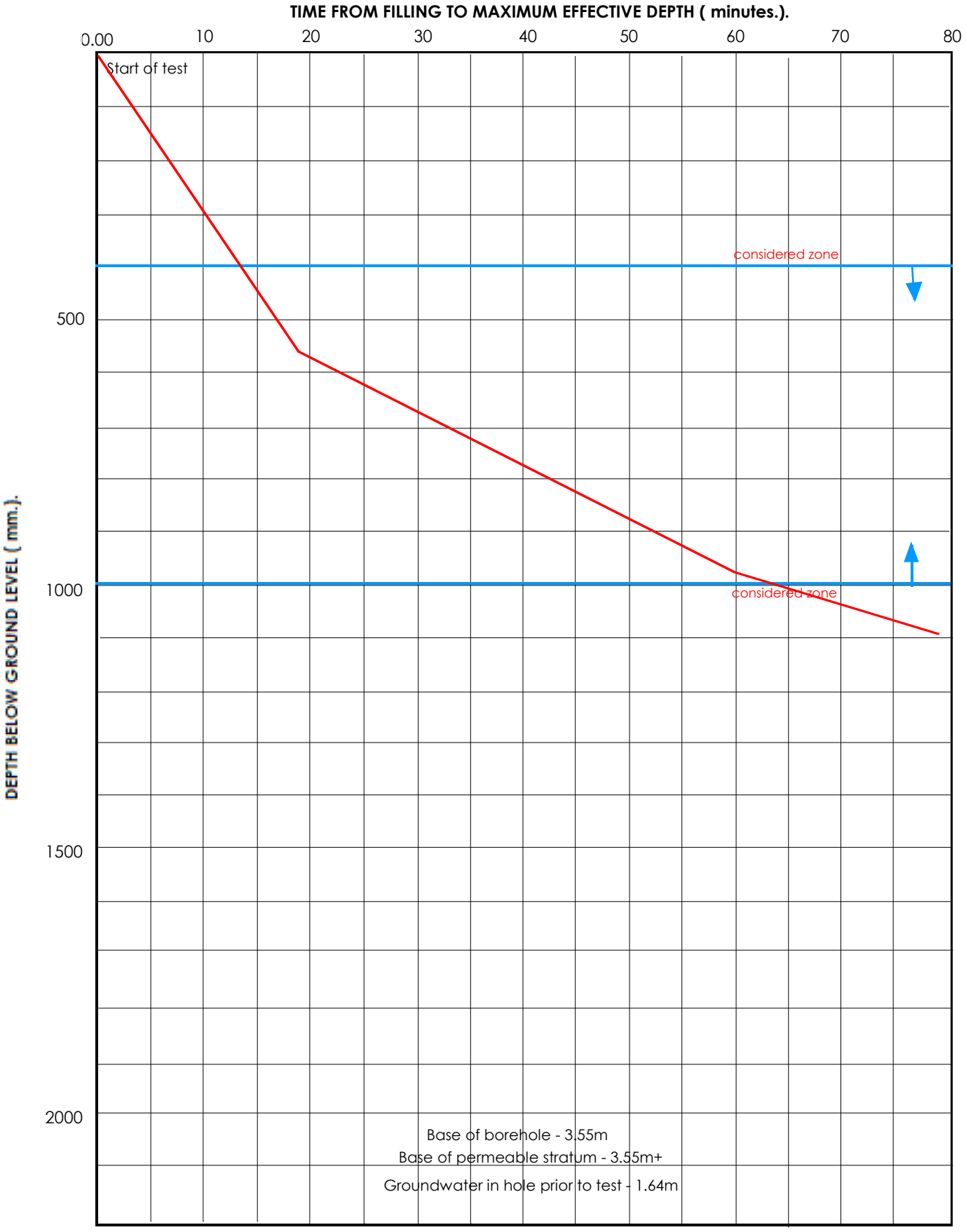


Percolation Graph

Falling Head Test

Soak BH6

Project Location : **Sproatley Road, Preston.**
Client : **Ward Homes**
Date of SI : **04.12.2020**

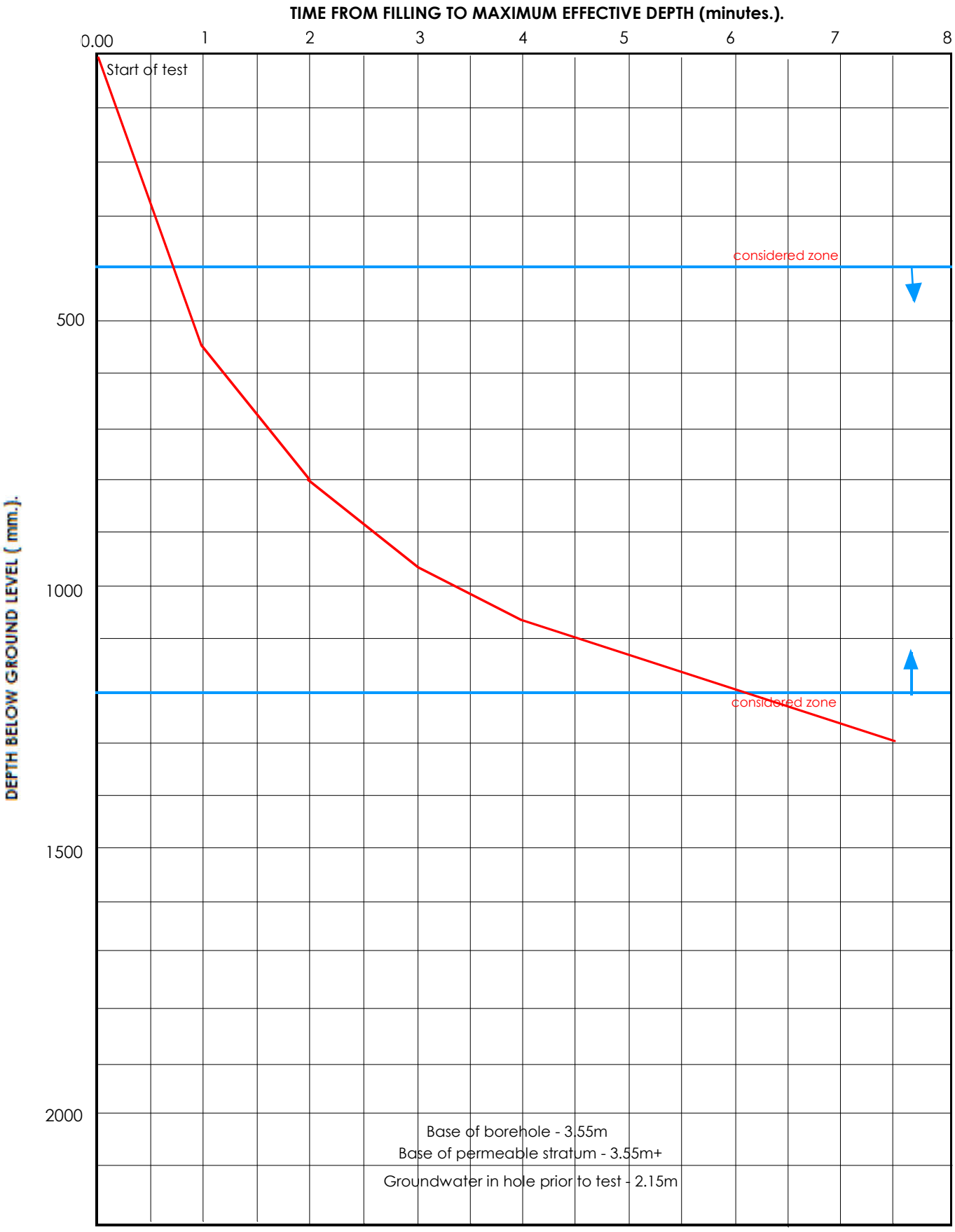


Percolation Graph

Falling Head Test

Soak BH7

Project Location : **Sproatley Road, Preston.**
Client : **Ward Homes**
Date of SI : **04.12.2020**



Calculation of Soil Infiltration Rate
Sproatley Road, Preston

Parameter	BH1	BH3	BH6	BH7			
diameter of borehole	0.105	0.105	0.105	0.105			
Height of water at start of considered zone (m) H1	1.11	0.8925	1.24	1.55			
Height of water at end of considered zone (m) H2	0.37	0.2975	0.64	0.95			
Considered depth change (m) = H1 - H2	0.74	0.595	0.6	0.6			
Volume out flowing within considered depth (50% void ratio)	0.003203836	0.002576057	0.002597704	0.002597704			
Mean effective depth during outflow	0.74	0.595	0.94	1.25			
Mean surface area during outflow	0.252760768	0.204930019	0.318734214	0.420993057			
Time of considered outflow (mins)	11	5	50	5.5			
Soil infiltration rate m/s	1.92E-05	4.19E-05	2.72E-06	1.87E-05			
Soil infiltration rate mm/s	1.92E-02	4.19E-02	2.72E-03	1.87E-02			
Soil infiltration rate m/hour	0.0691	0.1508	0.0098	0.0673			

Calculations from BRE 365 1991

Typical Percolation Values	Value mm/s
Gravels	>10
Sands	1 to 1 x 10E-2
Fine Sands / Coarse Silts	1x10E-2 to 1 x 10E-4
Silts	1x10E-4 to 1 x 10E-6
Clays	< 1 x 10E-6

Table from - Elements of Soil Mechanics for Civil & Mining Engineers (G .N. Smith 1974)

Summary of Lab Test Data

Moisture Content and Plasticity

Client	Ward Homes Yorkshire
Location	Sproatley Road, Preston
Job No.	as above
Date of SI	04 - 16.12.2020

Sample Details			Classification						
No. Type	Depth (m)	Description	w%	%<425µ	wa%	LL%	PL%	PI%	I'p%
SA1	1.10	Glacial Boulder Clay	23.2	99	23.4	39.8	12.4	27.4	27.1
SA1	2.00	Glacial Boulder Clay	22.1	100	22.1	40.1	13.2	26.9	26.9

Key

BS1377	%<425µ	Percent Passing 425 Micron Sieve
BS1377	w%	Natural Moisture Content
BS1377	wa%	Corrected w% for <425 Micron
BS1377	LL%	Liquid Limit of Sample >425 Micron removed
BS1377	PL%	Plastic Limit of Sample >425 Micron removed
BS1377	PI%	Plastic Index LL% - PL%
NHBC 4.2	I'p%	Modified Plasticity Index for <425 micron - NHBC 4.2

Liquid limit determinations performed on soil samples in natural state <425 micron particle size, using one point method in accordance with BS 1377 Part 2

Plastic limit determinations performed on soil samples in natural state <425 micron particle size in accordance with BS 1377 Part 2

Notes - Classification

NP	Non Plastic
CL	Clay of Low Plasticity
CI	Clay of Intermediate Plasticity
CH	Clay of High Plasticity
CV	Clay of Very High Plasticity
CE	Clay of Extremely High Plasticity
ML	Silt of Low Plasticity
MI	Silt of Intermediate Plasticity
MH	Silt of High Plasticity
MV	Silt of Very High Plasticity
ME	Silt of Extremely High Plasticity

Based on Plasticity Chart Fig 31. (B.S. 5930 - 1981)

2531

ANALYTICAL TEST REPORT

Contract no: 91712

Contract name: Sproatley Road, Preston

Client reference: 07122020

Clients name: TLP Ground Investigations

Clients address: 64 Wentworth Road
South Park Industrial Estate
Scunthorpe
DN17 2AZ

Samples received: 08 December 2020

Analysis started: 08 December 2020

Analysis completed: 15 December 2020

Report issued: 15 December 2020

Notes:

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.
BTEX compounds are identified by retention time only and may include interference from co-eluting compounds.

Key:

U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing
NAD No Asbestos Detected

Approved by:

J. Campbell

John Campbell
Director

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are inclusive of stones.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
91712-1	BH1	0.20-0.30	Loam with Gravel & Roots	-	-	19.6
91712-2	BH1	0.35-0.50	Sandy Loam with Gravel & Roots	-	-	14.5
91712-3	BH2	0.20-0.40	Sandy Loam with Gravel & Roots	-	-	16.2
91712-4	BH3	0.20-0.40	Sand with Gravel	-	-	10.3
91712-5	BH4	0.20-0.40	Loamy Clay with Gravel & Roots	-	-	21.3
91712-6	BH4	0.90-1.00	Clayey Sand with Gravel & Roots	-	-	16.0
91712-7	BH5	0.20-0.40	Loamy Sand with Gravel & Roots	-	-	15.1
91712-8	BH6	0.20-0.40	Loamy Sand with Gravel & Roots	-	-	15.7
91712-9	BH7	0.20-0.35	Loamy Sand with Gravel & Roots	-	-	15.3
91712-10	BH8	0.10-0.30	Loamy Sand with Gravel & Roots	-	-	12.3
91712-11	BH8	0.30-0.50	Sandy Loam with Gravel & Roots	-	-	15.9
91712-12	BH8	0.90-1.00	Sand with Gravel	-	-	14.0

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SOILS

Lab number			91712-1	91712-2	91712-3	91712-4	91712-5	91712-7
Sample id			BH1	BH1	BH2	BH3	BH4	BH5
Depth (m)			0.20-0.30	0.35-0.50	0.20-0.40	0.20-0.40	0.20-0.40	0.20-0.40
Date sampled			07/12/2020	07/12/2020	07/12/2020	07/12/2020	07/12/2020	07/12/2020
Test	**Method**	**Units**						
Arsenic (total)	CE127	mg/kg As	20	18	15	14	19	13
Boron (water soluble)	CE063 M	mg/kg B	1.7	1.4	0.9	1.3	4.0	1.4
Cadmium (total)	CE127	mg/kg Cd	0.3	<0.2	0.2	<0.2	0.2	0.9
Chromium (total)	CE127	mg/kg Cr	76	75	83	78	68	89
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE127	mg/kg Cu	62	32	63	31	34	24
Lead (total)	CE127	mg/kg Pb	330	112	77	74	170	59
Mercury (total)	CE127	mg/kg Hg	<0.5	0.8	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE127	mg/kg Ni	20	18	18	19	32	19
Selenium (total)	CE127	mg/kg Se	1.1	0.9	1.0	1.0	1.3	1.0
Zinc (total)	CE127	mg/kg Zn	178	81	111	81	126	75
pH	CE004 M	units	7.1	7.2	6.7	6.6	7.3	7.3
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	70	15	12	19	24	48
Sulphate (total)	CE062 M	mg/kg SO_4	812	507	404	442	688	391
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Thiocyanate	CE145 M	mg/kg SCN	1.4	<1	2.2	1.8	1.3	1.3
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	<0.5	<0.5	<0.5	7.8
Total Organic Carbon (TOC)	CE197	% w/w C	4.7	2.3	1.5	1.9	3.6	0.9
Estimate of OMC (calculated from TOC)	CE197	% w/w	8.2	3.9	2.6	3.3	6.2	1.5
Loss On Ignition at 440°C	CE006 U	% w/w	9.5	5.1	5.2	5.3	11.1	3.9
PAH								
Naphthalene	CE087 M	mg/kg	0.05	0.06	0.03	<0.02	<0.02	<0.02
Acenaphthylene	CE087 M	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	CE087 M	mg/kg	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
Fluorene	CE087 U	mg/kg	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
Phenanthrene	CE087 M	mg/kg	0.23	0.27	0.11	0.11	0.14	0.02
Anthracene	CE087 U	mg/kg	0.07	0.07	<0.02	0.02	0.04	<0.02
Fluoranthene	CE087 M	mg/kg	0.61	0.32	0.27	0.25	0.41	0.03
Pyrene	CE087 M	mg/kg	0.56	0.27	0.24	0.24	0.34	0.03
Benzo(a)anthracene	CE087 U	mg/kg	0.33	0.15	0.14	0.16	0.18	<0.02
Chrysene	CE087 M	mg/kg	0.40	0.17	0.17	0.20	0.22	<0.03
Benzo(b)fluoranthene	CE087 M	mg/kg	0.53	0.18	0.24	0.26	0.25	<0.02
Benzo(k)fluoranthene	CE087 M	mg/kg	0.19	0.06	0.09	0.11	0.08	<0.03
Benzo(a)pyrene	CE087 U	mg/kg	0.37	0.13	0.15	0.19	0.17	<0.02
Indeno(123cd)pyrene	CE087 M	mg/kg	0.31	0.10	0.14	0.17	0.13	<0.02
Dibenz(ah)anthracene	CE087 M	mg/kg	0.06	<0.02	0.02	0.03	<0.02	<0.02
Benzo(ghi)perylene	CE087 M	mg/kg	0.28	0.09	0.13	0.15	0.12	<0.02
PAH (total of USEPA 16)	CE087	mg/kg	3.99	1.92	1.72	1.89	2.08	<0.34

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SOILS

Lab number			91712-1	91712-2	91712-3	91712-4	91712-5	91712-7
Sample id			BH1	BH1	BH2	BH3	BH4	BH5
Depth (m)			0.20-0.30	0.35-0.50	0.20-0.40	0.20-0.40	0.20-0.40	0.20-0.40
Date sampled			07/12/2020	07/12/2020	07/12/2020	07/12/2020	07/12/2020	07/12/2020
Test	**Method**	**Units**						
TPH								
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
EPH Aromatic (>EC10-EC12)	CE068	mg/kg	<1	<1	<1	<1	<1	<1
EPH Aromatic (>EC12-EC16)	CE068	mg/kg	<1	<1	<1	<1	<1	<1
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	2	<1	<1	<1	<1	<1
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	3	<1	<1	2	2	<1
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	<1	<1	<1	<1	<1	<1
VPH Aliphatic (>C5-C6)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VPH Aliphatic (>C6-C8)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VPH Aliphatic (>C8-C10)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
EPH Aliphatic (>C10-C12)	CE068	mg/kg	<4	<4	<4	<4	<4	<4
EPH Aliphatic (>C12-C16)	CE068	mg/kg	<4	<4	<4	<4	<4	<4
EPH Aliphatic (>C16-C35)	CE068	mg/kg	49	36	26	22	20	6
EPH Aliphatic (>C35-C44)	CE068	mg/kg	<10	<10	<10	<10	<10	<10
Subcontracted analysis								
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD	NAD	NAD

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SOILS

Lab number			91712-8	91712-9	91712-10	91712-11
Sample id			BH6	BH7	BH8	BH8
Depth (m)			0.20-0.40	0.20-0.35	0.10-0.30	0.30-0.50
Date sampled			07/12/2020	07/12/2020	07/12/2020	07/12/2020
Test	**Method**	**Units**				
Arsenic (total)	CE127	mg/kg As	15	17	13	16
Boron (water soluble)	CE063 M	mg/kg B	1.1	0.9	0.8	1.0
Cadmium (total)	CE127	mg/kg Cd	<0.2	0.3	<0.2	0.2
Chromium (total)	CE127	mg/kg Cr	80	77	80	85
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1
Copper (total)	CE127	mg/kg Cu	41	56	31	60
Lead (total)	CE127	mg/kg Pb	72	165	51	112
Mercury (total)	CE127	mg/kg Hg	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE127	mg/kg Ni	16	20	16	19
Selenium (total)	CE127	mg/kg Se	0.8	1.0	0.8	0.9
Zinc (total)	CE127	mg/kg Zn	107	138	76	138
pH	CE004 M	units	6.8	6.6	6.8	6.7
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	30	18	10	14
Sulphate (total)	CE062 M	mg/kg SO_4	451	524	296	525
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<1	<1	<1	<1
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1
Thiocyanate	CE145 M	mg/kg SCN	2.6	2.9	<1	2.1
Phenols (total)	CE078	mg/kg PhOH	0.6	<0.5	0.7	<0.5
Total Organic Carbon (TOC)	CE197	% w/w C	1.4	2.2	4.0	3.9
Estimate of OMC (calculated from TOC)	CE197	% w/w	2.3	3.8	6.9	6.7
Loss On Ignition at 440°C	CE006 U	% w/w	4.9	6.9	3.1	7.2
PAH						
Naphthalene	CE087 M	mg/kg	0.05	0.12	<0.02	0.06
Acenaphthylene	CE087 M	mg/kg	<0.02	<0.02	<0.02	<0.02
Acenaphthene	CE087 M	mg/kg	<0.02	<0.02	<0.02	0.08
Fluorene	CE087 U	mg/kg	<0.02	<0.02	<0.02	0.05
Phenanthrene	CE087 M	mg/kg	0.15	0.13	<0.02	0.66
Anthracene	CE087 U	mg/kg	0.04	0.03	<0.02	0.18
Fluoranthene	CE087 M	mg/kg	0.34	0.33	0.04	1.11
Pyrene	CE087 M	mg/kg	0.30	0.30	0.04	0.98
Benzo(a)anthracene	CE087 U	mg/kg	0.18	0.17	0.02	0.51
Chrysene	CE087 M	mg/kg	0.22	0.23	0.03	0.61
Benzo(b)fluoranthene	CE087 M	mg/kg	0.28	0.29	0.03	0.76
Benzo(k)fluoranthene	CE087 M	mg/kg	0.11	0.11	<0.03	0.29
Benzo(a)pyrene	CE087 U	mg/kg	0.19	0.20	0.02	0.52
Indeno(123cd)pyrene	CE087 M	mg/kg	0.16	0.17	<0.02	0.43
Dibenz(ah)anthracene	CE087 M	mg/kg	0.03	0.03	<0.02	0.09
Benzo(ghi)perylene	CE087 M	mg/kg	0.15	0.16	<0.02	0.39
PAH (total of USEPA 16)	CE087	mg/kg	2.20	2.28	<0.34	6.72

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SOILS

Lab number			91712-8	91712-9	91712-10	91712-11
Sample id			BH6	BH7	BH8	BH8
Depth (m)			0.20-0.40	0.20-0.35	0.10-0.30	0.30-0.50
Date sampled			07/12/2020	07/12/2020	07/12/2020	07/12/2020
Test	**Method**	**Units**				
TPH						
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01
EPH Aromatic (>EC10-EC12)	CE068	mg/kg	<1	<1	<1	<1
EPH Aromatic (>EC12-EC16)	CE068	mg/kg	<1	<1	<1	<1
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	<1	<1	<1	4
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	2	2	<1	4
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	<1	<1	<1	<1
VPH Aliphatic (>C5-C6)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1
VPH Aliphatic (>C6-C8)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1
VPH Aliphatic (>C8-C10)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1
EPH Aliphatic (>C10-C12)	CE068	mg/kg	<4	<4	<4	<4
EPH Aliphatic (>C12-C16)	CE068	mg/kg	<4	<4	<4	4
EPH Aliphatic (>C16-C35)	CE068	mg/kg	28	12	8	58
EPH Aliphatic (>C35-C44)	CE068	mg/kg	<10	<10	<10	<10
Subcontracted analysis						
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD

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SOILS

Lab number			91712-6	91712-12
Sample id			BH4	BH8
Depth (m)			0.90-1.00	0.90-1.00
Date sampled			07/12/2020	07/12/2020
Test	**Method**	**Units**		
VPH (>C5-C10)	CE067	mg/kg	0.2	0.2
EPH (>C10-C16)	CE033	mg/kg	<7	<7
EPH (>C16-C40)	CE033	mg/kg	<6	7
VOC (total) inc TICs	CE174 [1,2]	mg/kg	<0.01	<0.01
BTEX & MTBE (total)	CE057 [2]	mg/kg	<0.02	<0.02
SVOC (total) inc TICs	CE189 [2,3]	mg/kg	<0.1	<0.1
Phenols (total)	CE189 [2]	mg/kg	<0.1	<0.1
Cresols & chlorinated phenols (total)	CE189 [2]	mg/kg	<0.01	<0.01
Ethers*	CE189 [2]	mg/kg	<0.1	<0.1
Nitrobenzene*	CE189 [2]	mg/kg	<0.1	<0.1
Ketones*	CE189 [2]	mg/kg	<0.01	<0.01
Aldehydes*	CE189 [2]	mg/kg	<0.01	<0.01
Amines*	CE189 [2]	mg/kg	<0.1	<0.1
pH	CE004 [M]	units	7.4	6.9
Electrical conductivity	CE007 [U]	µS/cm	134	52
Redox potential	CE082	mV	287	307

Notes
1: Total VOCs (excluding BTEX & MTBE)
2: LOD applies to each compound
3: Total SVOCs (excluding PAHs and those substances marked with an *)

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WATERS

Lab number			91712-13	91712-14
Sample id			BH2	BH7
Depth (m)			1.43	1.74
Date sampled			07/12/2020	07/12/2020
Time sampled			-	-
Test	**Method**	**Units**		
Arsenic (dissolved)	CE128 U	µg/l As	1.33	0.94
Boron (dissolved)	CE128 U	µg/l B	58	42
Cadmium (dissolved)	CE128 U	µg/l Cd	<0.07	<0.07
Chromium (dissolved)	CE128 U	µg/l Cr	<0.2	<0.2
Chromium VI (dissolved)	CE050 U	µg/l CrVI	<10	<10
Copper (dissolved)	CE128 U	µg/l Cu	10.2	2.9
Lead (dissolved)	CE128 U	µg/l Pb	<0.2	<0.2
Mercury (dissolved)	CE128 U	µg/l Hg	<0.008	<0.008
Nickel (dissolved)	CE128 U	µg/l Ni	2.9	1.3
Selenium (dissolved)	CE128 U	µg/l Se	0.50	0.46
Zinc (dissolved)	CE128 U	µg/l Zn	4	<1
pH	CE213 U	units	8.5	8.5
Sulphate	CE049 U	mg/l SO_4	48	63
Sulphide	CE079	µg/l S^{2-}	<100	<100
Cyanide (free)	CE147	µg/l CN	<20	<20
Cyanide (total)	CE147	µg/l CN	<20	<20
Thiocyanate	CE014 U	µg/l SCN	219	<200
Phenols (total)	CE148	µg/l PhOH	<10	<10
Total Organic Carbon	CE204	mg/l C	<5	<5
PAH				
Naphthalene	CE051	µg/l	<0.1	<0.1
Acenaphthylene	CE051	µg/l	<0.1	<0.1
Acenaphthene	CE051	µg/l	<0.1	<0.1
Fluorene	CE051	µg/l	<0.1	<0.1
Phenanthrene	CE051	µg/l	<0.1	<0.1
Anthracene	CE051	µg/l	<0.1	<0.1
Fluoranthene	CE051	µg/l	<0.1	<0.1
Pyrene	CE051	µg/l	<0.1	<0.1
Benzo(a)anthracene	CE051	µg/l	<0.1	<0.1
Chrysene	CE051	µg/l	<0.1	<0.1
Benzo(b)fluoranthene	CE051	µg/l	<0.1	<0.1
Benzo(k)fluoranthene	CE051	µg/l	<0.1	<0.1
Benzo(a)pyrene	CE051	µg/l	<0.1	<0.1
Indeno(123cd)pyrene	CE051	µg/l	<0.1	<0.1
Dibenz(ah)anthracene	CE051	µg/l	<0.1	<0.1
Benzo(ghi)perylene	CE051	µg/l	<0.1	<0.1
PAH (total of USEPA 16)	CE051	µg/l	<1.6	<1.6
BTEX & TPH				
Benzene	CE057 U	µg/l	<1	<1
Toluene	CE057 U	µg/l	<1	<1

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WATERS

Lab number			91712-13	91712-14
Sample id			BH2	BH7
Depth (m)			1.43	1.74
Date sampled			07/12/2020	07/12/2020
Time sampled			-	-
Test	**Method**	**Units**		
Ethylbenzene	CE057 U	µg/l	<1	<1
m & p-Xylene	CE057 U	µg/l	<2	<2
o-Xylene	CE057 U	µg/l	<1	<1
VPH Aromatic (>EC5-EC7)	CE175	µg/l	<1	<1
VPH Aromatic (>EC7-EC8)	CE175	µg/l	<1	<1
VPH Aromatic (>EC8-EC10)	CE175	µg/l	<1	<1
EPH Aromatic (>EC10-EC12)	CE161	µg/l	<1	<1
EPH Aromatic (>EC12-EC16)	CE161	µg/l	<1	<1
EPH Aromatic (>EC16-EC21)	CE161	µg/l	<1	<1
EPH Aromatic (>EC21-EC35)	CE161	µg/l	<1	<1
EPH Aromatic (>EC35-EC44)	CE161	µg/l	<1	<1
VPH Aliphatic (>C5-C6)	CE175	µg/l	<1	<1
VPH Aliphatic (>C6-C8)	CE175	µg/l	<1	<1
VPH Aliphatic (>C8-C10)	CE175	µg/l	<1	<1
EPH Aliphatic (>C10-C12)	CE161	µg/l	<1	<1
EPH Aliphatic (>C12-C16)	CE161	µg/l	2	4
EPH Aliphatic (>C16-C35)	CE161	µg/l	9	21
EPH Aliphatic (>C35-C44)	CE161	µg/l	<1	<1

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry		1	mg/kg As
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	M	0.5	mg/kg B
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry		0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry		1	mg/kg Cr
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry		1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry		1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry		0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry		1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry		0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry		5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO_4
CE062	Sulphate (total)	Acid extraction, ICP-OES	Dry	M	100	mg/kg SO_4
CE079	Sulphide	Extraction, Continuous Flow Colorimetry	As received		10	mg/kg S^{2-}
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE145	Thiocyanate	Weak acid extraction, Colorimetry	Dry	M	1	mg/kg SCN
CE078	Phenols (total)	Extraction, Continuous Flow Colorimetry	As received		0.5	mg/kg PhOH
CE197	Total Organic Carbon (TOC)	Carbon Analyser	Dry		0.1	% w/w C
CE197	Estimate of OMC (calculated from TOC)	Calculation from Total Organic Carbon	Dry		0.1	% w/w
CE006	Loss On Ignition at 440°C	Based on BS 1377, Gravimetry	Dry	U	0.1	% w/w
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
CE067	VPH Aromatic (>EC5-EC7)	Headspace GC-FID	As received		0.01	mg/kg
CE067	VPH Aromatic (>EC7-EC8)	Headspace GC-FID	As received		0.01	mg/kg
CE067	VPH Aromatic (>EC8-EC10)	Headspace GC-FID	As received		0.01	mg/kg
CE068	EPH Aromatic (>EC10-EC12)	Solvent extraction, GC-FID	As received		1	mg/kg
CE068	EPH Aromatic (>EC12-EC16)	Solvent extraction, GC-FID	As received		1	mg/kg

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE068	EPH Aromatic (>EC16-EC21)	Solvent extraction, GC-FID	As received		1	mg/kg
CE068	EPH Aromatic (>EC21-EC35)	Solvent extraction, GC-FID	As received		1	mg/kg
CE068	EPH Aromatic (>EC35-EC44)	Solvent extraction, GC-FID	As received		1	mg/kg
CE067	VPH Aliphatic (>C5-C6)	Headspace GC-FID	As received		0.1	mg/kg
CE067	VPH Aliphatic (>C6-C8)	Headspace GC-FID	As received		0.1	mg/kg
CE067	VPH Aliphatic (>C8-C10)	Headspace GC-FID	As received		0.1	mg/kg
CE068	EPH Aliphatic (>C10-C12)	Solvent extraction, GC-FID	As received		4	mg/kg
CE068	EPH Aliphatic (>C12-C16)	Solvent extraction, GC-FID	As received		4	mg/kg
CE068	EPH Aliphatic (>C16-C35)	Solvent extraction, GC-FID	As received		4	mg/kg
CE068	EPH Aliphatic (>C35-C44)	Solvent extraction, GC-FID	As received		10	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE067	VPH (>C5-C10)	Headspace GC-FID	As received		0.1	mg/kg
CE033	EPH (>C10-C16)	Solvent extraction, GC-FID	As received		7	mg/kg
CE033	EPH (>C16-C40)	Solvent extraction, GC-FID	As received		6	mg/kg
CE174	Volatile Organic Compounds	Headspace GC-MS	As received		0.01	mg/kg
CE174	VOC Tentatively Identified Compounds	Headspace GC-MS	As received		-	-
CE057	BTEX & MTBE (total)	Headspace GC-FID	As received		0.02	mg/kg
CE189	Semi-volatile Organic Compounds	Solvent extraction, GC-MS	As received		0.01-0.1	mg/kg
CE189	SVOC Tentatively Identified Compounds	Solvent extraction, GC-MS	As received		-	-
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE007	Electrical conductivity	Conductivity Meter	As received	U	10	µS/cm
CE082	Redox potential	ORP meter	As received		±1	mV

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METHOD DETAILS

METHOD	WATERS	METHOD SUMMARY	STATUS	LOD	UNITS
CE128	Arsenic (dissolved)	ICP-MS	U	0.06	µg/l As
CE128	Boron (dissolved)	ICP-MS	U	8	µg/l B
CE128	Cadmium (dissolved)	ICP-MS	U	0.07	µg/l Cd
CE128	Chromium (dissolved)	ICP-MS	U	0.2	µg/l Cr
CE050	Chromium VI (dissolved)	Colorimetry	U	10	µg/l CrVI
CE128	Copper (dissolved)	ICP-MS	U	0.4	µg/l Cu
CE128	Lead (dissolved)	ICP-MS	U	0.2	µg/l Pb
CE128	Mercury (dissolved)	ICP-MS	U	0.008	µg/l Hg
CE128	Nickel (dissolved)	ICP-MS	U	0.5	µg/l Ni
CE128	Selenium (dissolved)	ICP-MS	U	0.07	µg/l Se
CE128	Zinc (dissolved)	ICP-MS	U	1	µg/l Zn
CE213	pH	Based on BS 1377, pH Meter	U	-	units
CE049	Sulphate	Ion Chromatography	U	1.7	mg/l SO_4
CE079	Sulphide	Continuous Flow Colorimetry		100	µg/l S2-
CE147	Cyanide (free)	Continuous Flow Colorimetry		20	µg/l CN
CE147	Cyanide (total)	Continuous Flow Colorimetry		20	µg/l CN
CE014	Thiocyanate	Colorimetry	U	200	µg/l SCN
CE148	Phenols (total)	Continuous Flow Colorimetry		10	µg/l PhOH
CE204	Total Organic Carbon	Colorimetry		5	mg/l C
CE051	Naphthalene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Acenaphthylene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Acenaphthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Fluorene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Phenanthrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(a)anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Chrysene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(b)fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(k)fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(a)pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Indeno(123cd)pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Dibenz(ah)anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(ghi)perylene	Solvent extraction, GC-MS		0.1	µg/l
CE051	PAH (total of USEPA 16)	Solvent extraction, GC-MS		1.6	µg/l
CE057	Benzene	Headspace GC-FID	U	1	µg/l
CE057	Toluene	Headspace GC-FID	U	1	µg/l
CE057	Ethylbenzene	Headspace GC-FID	U	1	µg/l
CE057	m & p-Xylene	Headspace GC-FID	U	2	µg/l
CE057	o-Xylene	Headspace GC-FID	U	1	µg/l
CE175	VPH Aromatic (>EC5-EC7)	Headspace GC-FID		1	µg/l
CE175	VPH Aromatic (>EC7-EC8)	Headspace GC-FID		1	µg/l
CE175	VPH Aromatic (>EC8-EC10)	Headspace GC-FID		1	µg/l

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METHOD DETAILS

METHOD	WATERS	METHOD SUMMARY	STATUS	LOD	UNITS
CE161	EPH Aromatic (>EC10-EC12)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aromatic (>EC12-EC16)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aromatic (>EC16-EC21)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aromatic (>EC21-EC35)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aromatic (>EC35-EC44)	Solvent extraction, GC-FID		1	µg/l
CE175	VPH Aliphatic (>C5-C6)	Headspace GC-FID		1	µg/l
CE175	VPH Aliphatic (>C6-C8)	Headspace GC-FID		1	µg/l
CE175	VPH Aliphatic (>C8-C10)	Headspace GC-FID		1	µg/l
CE161	EPH Aliphatic (>C10-C12)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aliphatic (>C12-C16)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aliphatic (>C16-C35)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aliphatic (>C35-C44)	Solvent extraction, GC-FID		1	µg/l

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DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
91712-1	BH1	0.20-0.30	N	
91712-2	BH1	0.35-0.50	N	
91712-3	BH2	0.20-0.40	N	
91712-4	BH3	0.20-0.40	N	
91712-5	BH4	0.20-0.40	N	
91712-6	BH4	0.90-1.00	N	
91712-7	BH5	0.20-0.40	N	
91712-8	BH6	0.20-0.40	N	
91712-9	BH7	0.20-0.35	N	
91712-10	BH8	0.10-0.30	N	
91712-11	BH8	0.30-0.50	N	
91712-12	BH8	0.90-1.00	N	
91712-13	BH2	1.43	N	
91712-14	BH7	1.74	N	

Residential With Plant

Metals & Semi Metals + PAH

Statistical Analysis of Contamination Test Results

0 - 3.5% SOM use SSV values relating to SOM 1% (only if sandy soil)

for 3.5% to 6+% SOM or non sandy soil use SSV values relating to SOM 6.0%

SITE	Sproatley Road, Preston
CARRIED OUT FOR	Ward Homes Yorkshire
END USE	Residential With Plant Uptake

TEST RESULTS

Determinant	Units	Atrisk SSV Commer / Res out / Res with	Position	BH1	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8	BH8
			Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			Depth	0.20-0.30	0.35-0.50	0.20-0.40	0.20-0.40	0.20-0.40	0.20-0.40	0.20-0.40	0.20-0.35	0.10-0.30	0.30-0.50
Boron (hot water soluble)	mg kg-1	old TCRCL	Not Normal	1.7	1.4	0.9	1.3	4.0	1.4	1.1	0.9	0.8	1.0
Sulfate (2:1 water soluble)	g l-1		Normal	70	15	12	19	24	48	30	18	10	14
Cyanide (free)	mg kg-1	Atrisk SSV	Not Normal	1	1	1	1	1	1	1	1	1	1
Cyanide (total)	mg kg-1		Not Normal	1	1	1	1	1	1	1	1	1	1
Thiocyanate			Normal	1	1	2	2	1	1	3	3	1	2
Sulfide	mg kg-1		Not Normal	10	10	10	10	10	10	10	10	10	10
Sulfate (total)	%		Normal	812	507	404	442	688	391	451	524	296	525
Arsenic	mg kg-1	SGV (Not pC4SL higher value	Normal	19.5	17.9	15.0	14.4	19.3	13.4	14.6	17.5	12.5	16.0
Cadmium	mg kg-1	SGV (Not pC4SL higher value	Not Normal	0.3	0.2	0.2	0.2	0.2	0.9	0.2	0.3	0.2	0.2
Chromium	mg kg-1	Atrisk SSV	Normal	76	75	83	78	68	89	80	77	80	85
Copper	mg kg-1	Atrisk SSV	Normal	62	32	63	31	34	24	41	56	31	60
Mercury	mg kg-1	sing SGV - Mercury inorgani	Not Normal	0.5	0.8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Nickel	mg kg-1	SGV	Not Normal	20	18	18	19	32	19	16	20	16	19
Lead	mg kg-1	Lower Limit pC4SL	Not Normal	330	112	77	74	170	59	72	165	51	112
Selenium	mg kg-1	SGV	Normal	1.1	0.9	1.0	1.0	1.3	1.0	0.8	1.0	0.8	0.9
Zinc	mg kg-1	Atrisk SSV	Normal	178	81	111	81	126	75	107	138	76	138
Chromium (hexavalent)	mg kg-1	C4SL	Not Normal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Naphthalene	mg kg-1	Atrisk SSV	Normal	0.05	0.06	0.03	0.02	0.02	0.02	0.1	0.1	0.0	0.1
Acenaphthylene	mg kg-1		Not Normal	0.02	0.02	0.02	0.02	0.02	0.02	0.0	0.0	0.0	0.0
Acenaphthene	mg kg-1	Atrisk SSV	Not Normal	0.02	0.03	0.02	0.02	0.02	0.02	0.0	0.0	0.0	0.1
Fluorene	mg kg-1	Atrisk SSV	Not Normal	0.02	0.03	0.02	0.02	0.02	0.02	0.0	0.0	0.0	0.1
Phenanthrene	mg kg-1		Not Normal	0.23	0.27	0.11	0.11	0.14	0.02	0.2	0.1	0.0	0.7
Anthracene	mg kg-1	Atrisk SSV	Not Normal	0.07	0.07	0.02	0.02	0.04	0.02	0.0	0.0	0.0	0.2
Fluoranthene	mg kg-1	Atrisk SSV	Normal	0.61	0.32	0.27	0.25	0.41	0.03	0.3	0.3	0.0	1.1
Pyrene	mg kg-1	Atrisk SSV	Normal	0.56	0.27	0.24	0.24	0.34	0.03	0.3	0.3	0.0	1.0
Benzo[a]anthracene	mg kg-1	Atrisk SSV	Normal	0.33	0.15	0.14	0.16	0.18	0.02	0.2	0.2	0.0	0.5
Chrysene	mg kg-1	Atrisk SSV	Normal	0.40	0.17	0.17	0.20	0.22	0.03	0.2	0.2	0.0	0.6
Benzo[b]fluoranthene	mg kg-1	Atrisk SSV	Normal	0.53	0.18	0.24	0.26	0.25	0.02	0.3	0.3	0.0	0.8
Benzo[k]fluoranthene	mg kg-1	Atrisk SSV	Normal	0.19	0.06	0.09	0.11	0.08	0.03	0.1	0.1	0.0	0.3
Benzo[a]pyrene	mg kg-1	SSV (Not C4SL higher value)	Normal	0.37	0.13	0.15	0.19	0.17	0.02	0.2	0.2	0.0	0.5
Dibenzo[a,h]anthracene	mg kg-1	Atrisk SSV	Not Normal	0.06	0.02	0.02	0.03	0.02	0.02	0.0	0.0	0.0	0.1
Indeno[1,2,3-cd]pyrene	mg kg-1	Atrisk SSV	Normal	0.31	0.10	0.14	0.17	0.13	0.02	0.2	0.2	0.0	0.4
Benzo[g,h,i]perylene	mg kg-1	Atrisk SSV	Normal	0.28	0.09	0.13	0.15	0.12	0.02	0.2	0.2	0.0	0.4
Total (of 16) PAHs	mg kg-1		Normal	3.99	1.92	1.72	1.89	2.08	0.34	2.2	2.3	0.3	6.7
Phenols (total)	mg kg-1	SGV	Not Normal	0.5	0.5	0.5	0.5	0.5	7.8	0.6	0.5	0.7	0.5
pH	-		Normal	7.1	7.2	6.7	6.6	7.3	7.3	6.8	6.6	6.8	6.7
Loss on ignition	%		Normal	9.45	5.12	5.18	5.26	11.11	3.85	4.90	6.94	3.07	7.22
TOC	%		Normal	4.74	2.25	1.50	1.90	3.59	0.87	1.35	2.20	4.01	3.87
SOM	%		Normal	8.17	3.88	2.59	3.28	6.19	1.50	2.33	3.79	6.91	6.67
		Shaparo Wilk Normality test	Ditribution		average SOM	4.53103448							

Planning Scenario

One Sample T-Test (Mean Value Test) / Chebychev Theorem

Determinant		Boron	Sulfate 2:1	Cy (free)	Cy (total)	Thiocyan	Sulfide	Sulfate (t)	Arsenic	Cadmium	Chro (hex)	Copper	Mercury	Nickel	Lead	Selenium	Zinc	Chromium III	Naphth	Acenthyl
Number of samples		10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Mean		1.43	26.00	1.00	1.00	1.76	10.00	504.00	16.02	0.31	1.00	43.40	0.53	19.70	122.10	0.98	111.18	78.95	0.05	0.02
Unbiased standard deviation		0.95	19.06	0.00	0.00	0.67	0.00	149.91	2.44	0.22	0.00	15.02	0.11	4.53	84.03	0.15	34.22	5.82	0.03	0.00
Appropriate t value from CLEA table A1.1		1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83
T-Test 95% UCL		1.98	37.05	1.00	1.00	2.15	10.00	590.89	17.43	0.43	1.00	52.11	0.60	22.33	170.81	1.06	131.02	82.32	0.06	0.02
Chebychev Theorem 95% UCL		2.73	52.28	1.00	1.00	2.68	10.00	710.69	19.38	0.60	1.00	64.11	0.68	25.95	237.96	1.18	158.36	86.97	0.09	0.02
T-Test	Commercial, Hardcover Buildings	PASS		PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	
	Residential without plants			PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	
	Residential with plants			PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	
	Parks			PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	
	Playing Fields			PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	
	Open Spaces			PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	
Chebychev	Commercial, Hardcover Buildings	PASS		PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	
Theory	Residential without plants			PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	
	Residential with plants			PASS					PASS	PASS	PASS	PASS	PASS	PASS	FAIL	PASS	PASS	PASS	PASS	
	Parks			PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	
	Playing Fields			PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	
	Open Spaces			PASS					PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	

Pass = Reject Ho Hypothesis

Determinant		Acethene	Fluorine	Phenan.	Anthrace	Fluoranth	Pyrene	Benzo[a]anth	Chrysene	Benzo[b]fluo	Benzo[k]fluo	Benzo[a]pyre	Dibenzo[a,h]	Indeno[1,2,3-	Benzo[g,h,i]p	Total (of 16)	Phenols (tota	pH	LOI
Number of samples		10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Mean		0.03	0.02	0.18	0.05	0.37	0.33	0.19	0.23	0.28	0.11	0.20	0.03	0.17	0.15	2.35	1.26	6.91	6.21
Unbiased standard deviation		0.02	0.01	0.18	0.05	0.31	0.27	0.14	0.17	0.22	0.08	0.15	0.02	0.12	0.11	1.85	2.30	0.28	2.50
Appropriate t value from CLEA table A1.1		1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83
T-Test 95% UCL		0.04	0.03	0.29	0.08	0.55	0.49	0.27	0.33	0.41	0.16	0.28	0.05	0.24	0.22	3.42	2.60	7.07	7.66
Chebychev Theorem 95% UCL		0.05	0.04	0.44	0.12	0.80	0.71	0.38	0.46	0.59	0.22	0.40	0.07	0.34	0.31	4.90	4.44	7.30	9.66
T-Test	Commercial, Hardcover Buildings	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
	Residential without plants	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
	Residential with plants	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
	Parks	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
	Playing Fields	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
	Open Spaces	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
Chebychev	Commercial, Hardcover Buildings	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
Theory	Residential without plants	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
	Residential with plants	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
	Parks	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
	Playing Fields	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		
	Open Spaces	PASS	PASS		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		PASS		

Pass = Reject Ho Hypothesis

Calculations based on mixed zone (M)	600	mm

Sproatley Road, Preston

Contaminant	Site Data				Expressed as a Factor of Target Guideline Value				Cover Thickness Required for Compliance to Specified Target Guideline Value	
	Contamination of Ground (Cg)	Contamination of Cover (Cc)	Target Guideline Value 1 RESIDENTIAL WITH PLANT	Target Guideline Value 2 REESIDENTIAL RES WITHOUT	Target Guideline Value Soil / 1 RESIDENTIAL WITH PLANT	Target Guideline Value Cover / 1 RESIDENTIAL WITH PLANT	Target Guideline Value Soil / 2 REESIDENTIAL RES WITHOUT	Target Guideline Value Cover / 2 REESIDENTIAL RES WITHOUT	Target Guideline Value 1 RESIDENTIAL WITH PLANT	Target Guideline Value 2 REESIDENTIAL RES WITHOUT
	Units		Units		Fraction				(mm)	
Arsenic	20	10	37	39.9	0.5	0.3	0.5	0.3	None	None
Cadmium	0.9	0.3	22.1	149	0.0	0.0	0.0	0.0	None	None
Chromium	89	8	14300	16700	0.0	0.0	0.0	0.0	None	None
Chromium (VI)	1	0.5	3.62	3.62	0.3	0.1	0.3	0.1	None	None
Mercury	0.8	0.8	8.81	10	0.1	0.1	0.1	0.1	None	None
Selenium	1.3	0.3	375	595	0.0	0.0	0.0	0.0	None	None
Copper	63	25	4730	9060	0.0	0.0	0.0	0.0	None	None
Nickel	32	20	136	188	0.2	0.1	0.2	0.1	None	None
Zinc	178	60	20000	47000	0.0	0.0	0.0	0.0	None	None
Lead	330	20	200	313	1.7	0.1	1.1	0.1	252	33
Boron (Water sol)	4	0.7			No TV	No TV	No TV	No TV	No TV	No TV
Sulphate (total)		0.1	0.2	1	No Cg	0.5	No Cg	0.1	No Cg	No Cg
Phenols	7.8	0.1	267	570	0.0	0.0	0.0	0.0	None	None
Sulphide	10	5	250	500	0.0	0.0	0.0	0.0	None	None
Cyanide	1	0.4	34	34	0.0	0.0	0.0	0.0	None	None
Chrysene	0.61	8	15	15	0.0	0.5	0.0	0.5	None	None
dibenzo(a,h)anthracene	0.09	0.1			No TV	No TV	No TV	No TV	No TV	No TV
benzo(a)pyrene	0.53	0.6	4.95	5.34	0.1	0.1	0.1	0.1	None	None
benzo(a)anthracene	0.33	0.5	7.2	7.2	0.0	0.1	0.0	0.1	None	None
indeno(1,2,3,cd)pyrene	0.43	0.45	27	27	0.0	0.0	0.0	0.0	None	None
benzo(b)fluoranthene	0.29	0.8			No TV	No TV	No TV	No TV	No TV	No TV
napthalene	0.12	0.1	2.3	2.3	0.1	0.0	0.1	0.0	None	None
TPH ALI C10 - C12	4	1	81.7	81.8	0.0	0.0	0.0	0.0	None	None
TPH ALI C12 - C16	4	1	385	385	0.0	0.0	0.0	0.0	None	None
TPH ARO C5 - C7	0.01	0.02	0.137	0.31	0.1	0.1	0.0	0.1	None	None
Barium		4	56.8	1340	No Cg	0.1	No Cg	0.0	No Cg	No Cg

Summary		
	Target Guideline Value 1 RESIDENTIAL WITH PLANT	Target Guideline Value 2 REESIDENTIAL RES WITHOUT
Number of contaminants	26	26
Number of contaminants **with no** thickness calculation	5	5
Breakdown - Number for which no TV specfied	3	3
Breakdown - Number for which no soil specified	2	2
Breakdown - Number for which no cover specified	0	0
Breakdown - Number for which cover > TV	0	0
Number of contaminants **with** thickness calculation	21	21
Breakdown - Number for which no cover required	20	20
Breakdown - Number for which cover required	1	1

Overall thickness of cover required	**252**	**0**

DECLARATION OF COMPLIANCE (BS3882:2015)

Lab ref	91712-1	**Date received**	08 December 2020
Soil source	Sproatley Road, Preston BH1 0.20-0.30m	**Analysis started**	08 December 2020
OS Grid reference	Not supplied	**Analysis completed**	15 December 2020
Date sampled	07 December 2020	**Report issued**	15 December 2020

Test	Units	Result	Compliant with Multipurpose? (Y/N)	Compliant with specific purpose? (Y/N)				
				Acidic	Calcareous	Low Fertility	Low F Acidic	Low F Calcareous
Texture								
Clay content	% w/w	18	Y	Y	Y	Y	Y	Y
Silt content	% w/w	14	Y	Y	Y	Y	Y	Y
Sand content	% w/w	68	Y	Y	Y	Y	Y	Y
Soil texture	**class**	**SANDY LOAM**						
Stone content								
>2mm	% w/w	29	Y	Y	Y	Y	Y	Y
>20mm	% w/w	0	Y	Y	Y	Y	Y	Y
>50mm	% w/w	0	Y	Y	Y	Y	Y	Y
Mass loss on ignition								
Clay 5-20%	% w/w	9.5	Y	Y	Y	Y	Y	Y
Clay 20-35%	% w/w	-	-	-	-	-	-	-
pH	pH units	7.1	Y	N	N	Y	N	N
Carbonate (calcareous only)	% w/w	3.3			Y			Y
Nitrogen (total)	% w/w N	0.31	Y	Y	Y			
Carbon:Nitrogen ratio	-	15.3	Y	Y	Y	Y	Y	Y
Phosphorus (extractable)	mg/l P	220	N	N	N	N	N	N
Potassium (extractable)	mg/l K	368	Y	Y	Y			
Magnesium (extractable)	mg/l Mg	247	Y	Y	Y			
Electrical conductivity	µS/cm	50	Y					
Phytotoxic contaminants (by soil pH)								
Copper (Nitric acid extract)	mg/kg Cu	55	Y	Y	Y	Y	Y	Y
Nickel (Nitric acid extract)	mg/kg Ni	20	Y	Y	Y	Y	Y	Y
Zinc (Nitric acid extract)	mg/kg Zn	157	Y	Y	Y	Y	Y	Y
VISIBLE CONTAMINANTS								
(air-dried soil)	% w/w	0	Y	Y	Y	Y	Y	Y
...of which plastics	% w/w	0	Y	Y	Y	Y	Y	Y
Sharps	% w/w	0	Y	Y	Y	Y	Y	Y

DECLARATION

I certify that this sample has been analysed in accordance with BS3882:2015.

Signature J. Campbell

Name John Campbell

Position Director

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DECLARATION OF COMPLIANCE (BS3882:2015)

Lab ref	91712-10	**Date received**	08 December 2020
Soil source	Sproatley Road, Preston BH8 0.10-0.30m	**Analysis started**	08 December 2020
OS Grid reference	Not supplied	**Analysis completed**	15 December 2020
Date sampled	07 December 2020	**Report issued**	15 December 2020

Test	Units	Result	Compliant with Multipurpose? (Y/N)	Compliant with specific purpose? (Y/N)				
				Acidic	Calcareous	Low Fertility	Low F Acidic	Low F Calcareous
Texture								
Clay content	% w/w	14	Y	Y	Y	Y	Y	Y
Silt content	% w/w	7	Y	Y	Y	Y	Y	Y
Sand content	% w/w	80	Y	Y	Y	Y	Y	Y
Soil texture	**class**	**LOAMY SAND**						
Stone content								
>2mm	% w/w	16	Y	Y	Y	Y	Y	Y
>20mm	% w/w	0	Y	Y	Y	Y	Y	Y
>50mm	% w/w	0	Y	Y	Y	Y	Y	Y
Mass loss on ignition								
Clay 5-20%	% w/w	3.1	Y	Y	Y	Y	Y	Y
Clay 20-35%	% w/w	-	-	-	-	-	-	-
pH	pH units	6.8	Y	N	N	Y	N	N
Carbonate (calcareous only)	% w/w	13.0			Y			Y
Nitrogen (total)	% w/w N	0.21	Y	Y	Y			
Carbon:Nitrogen ratio	-	6.8	Y	Y	Y	Y	Y	Y
Phosphorus (extractable)	mg/l P	141	N	N	N	N	N	N
Potassium (extractable)	mg/l K	325	Y	Y	Y			
Magnesium (extractable)	mg/l Mg	149	Y	Y	Y			
Electrical conductivity	µS/cm	36	Y					
Phytotoxic contaminants (by soil pH)								
Copper (Nitric acid extract)	mg/kg Cu	31	Y	Y	Y	Y	Y	Y
Nickel (Nitric acid extract)	mg/kg Ni	15	Y	Y	Y	Y	Y	Y
Zinc (Nitric acid extract)	mg/kg Zn	76	Y	Y	Y	Y	Y	Y
VISIBLE CONTAMINANTS								
(air-dried soil)	% w/w	0	Y	Y	Y	Y	Y	Y
...of which plastics	% w/w	0	Y	Y	Y	Y	Y	Y
Sharps	% w/w	0	Y	Y	Y	Y	Y	Y

DECLARATION

I certify that this sample has been analysed in accordance with BS3882:2015.

Signature J. Campbell

Name John Campbell

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