Phase II Site Investigation Report

at Bridge Farm, Bridge Farm Road, Twyford, Berkshire, RH10 9PP

for Croudace Homes Ltd

Report Reference: LP3302

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EXECUTIVE SUMMARY

The site comprises an approximately 12Ha irregularly shaped plot of land situated to the east of the River Loddon and the west of the Henley to Twyford Railway Line in Twyford Berkshire. The majority of the site comprises open agricultural fields used for grazing livestock except for a small area in the centre of the site which is occupied by hardstanding and barns. It is proposed to develop the north and east of the site with 200 No. residential properties with private gardens including associated access roads and small areas of open green space. The southwest of the site is proposed as an area of public open space including two attenuation basins.

The site has been mapped as open fields throughout its history with the exception of two small gravel pits which were mapped on site between 1910 and the 1970s.

The site is mapped as being underlain by Alluvium in the southwest and Kempton Park Gravel elsewhere over the Seaford and Newhaven Chalk Formations. Ground conditions encountered on site generally comprised topsoil over interbedded sands, gravels and clays of the Kempton Park Gravel to between 0.8m and 4.0m bgl, over highly weathered chalk to the full depth of investigation (5.0m bgl). The depth to chalk was irregular across the site and showed a general deepening towards the north of the site. The ground conditions in the southwest of the site comprised very soft to firm clays and loose sands considered to represent the Alluvium over the chalk at depth. Investigation within the two gravel pits (TP106 and TP111) encountered made ground to between 1.5m and 2.3m bgl. Several of the trial pits were noted to be unstable with minor side collapses occurring during the investigation works.

Groundwater seepages were encountered between 1.0 and 3.0m bgl and were more prevalent towards the south and west of the site. Groundwater monitoring recorded groundwater levels between 1.28m and 1.94m bgl in the south of the site, but groundwater was not encountered in the upper 3.0m of the ground in the north of the site.

An allowable bearing capacity of 90kPa is recommended for the conventional 600mm wide strip foundations founded on the medium dense sands/gravels and firm clays below about 1.0m. Foundations extending into the chalk should be keyed into the rock head to ensure insitu chalk at formation level. However, it is noted that the site has been classified as a moderate risk of solution features low SPT results were recorded locally within the superficial deposits and the upper surface of the chalk. Further investigation and assessment of the potential for solution features is recommended and at this stage foundations should be designed to span 5m.

Given the granular nature of the soils on site, the presence of localised deep made ground and the excavation instability noted during the investigation, piled foundations may be a preferable foundation solution across some, or all, of the site. Should piled foundations be proposed,

further investigation comprising deep boreholes extending at least 5.0m below the base of the proposed pile will be required to enable pile design.

Discussions with the landowner following the investigation indicate that a "bomb hole" is present in the east of the site adjacent to the train line that was backfilled by his father. It is recommended that a detailed UXO risk assessment is completed prior to further intrusive works on site.

A preliminary assessment of the embodied carbon of the proposed foundations has been undertaken. To enable the assessment a proposed pile of 15m length and 400mm diameter has been assumed. Based on this LEAP's carbon calculator indicates that traditional footings would be the less carbon intensive option. It goes on to indicate that piled foundation would be the less carbon intensive option where conventional footings are extended more than 1.9m bgl.

Suspended floor slabs are recommended with piled foundations and where the potential for solution features has been identified. Soil sulphates in the DS-1 fall within BRE design class and the site conditions fall within the ACEC class AC-1.

The soils on site are suitable for soakaway drainage however shallow groundwater across the site means that storage capacity is likely to be limited. Furthermore, the chalk beneath the site is noted to be of a low density and as such all soakaways must be situated at least 10m from the nearest foundation. Although no significant evidence of solution features has been encountered on site to date the upper surface of the chalk was noted to be irregular and highly weathered. As such further investigation in the vicinity of any proposed soakaways is recommended to confirm that no soft loose soils indicative of a solution feature is present in these areas.

A geo-environmental risk assessment has been carried out. Contamination testing of the soils generally identified very low contaminant concentrations. However, lead and zinc concentrations above the generic assessment criteria were encountered within the made ground in TP106. The concentrations encountered would pose an unacceptable risk to future residents were retained in near surface soils in private gardens and areas of soft landscaping.

Although not identified to date the made ground may represent a localised gas source should pockets of degradable material be present. Furthermore, given the presence of large anthropogenic items within the made ground these soils present a potential settlement risk were they to be retained in place. As such excavation and replacement of this material is recommended. Installation of a clean capping solution may be required in these areas subject to further testing.

Preliminary recommendations are given for the remediation of contamination in the area of the pits. As a minimum, an allowance should be made for excavation of the made ground and placement of clean topsoil and potentially subsoil in the gravel pit areas where this coincides with gardens or soft landscaped areas.

Investigation in the area of the farmyard was not possible due to the area still being in use for livestock storage. Further investigation in this area once the site has been vacated and formation inspections following demolition and removal of the hardstanding is recommended.

As with any redevelopment site, there is always the risk of hitherto undetected contamination, and further investigations should be carried out prior to redevelopment.

Recommendations are given for the sustainable reuse on site, where it is not possible to reuse the soils on site or off site much of the soils are expected to be classified as non-hazardous for waste disposal purposes however the made ground encountered in TP106 would be classified as hazardous due to the elevated zinc content.

Signed:	[redacted] Adam Carr BSc MSc FGS
Countersigned:	[redacted] Georgina Donbroski BEng MSc DIC CEng MICE Registered Ground Engineering Professional
Date:	24 May 2023
Revision:	Issue 1

A INTRODUCTION

1 Authority

RSK Environment Ltd trading as Leap Environmental (hereafter referred to as LEAP) has been appointed by Croudace Homes Ltd to undertake a Phase II intrusive Site Investigation of a site referred to as Twyford Bridge Farm, Twyford, Berkshire, RG10 9PP (Figure 1, Appendix B). The instruction was given in an email dated 21/03/23 and signed by Fraser Campbell of Croudace Homes.

2 Proposed Development

LEAP understands that the site is currently owned by a local resident, and it is proposed for Croudace to purchase and redevelop the north and east areas of the site with 200 No. two to three storey residential dwellings along with associated private gardens and access roads as per the attached layout in Figure 2, Appendix B. It is understood that the southwest of the site will serve as public open space including two attenuation ponds for SUDs drainage.

The proposed development has been assessed in accordance with BS EN 1997[1], as being a Geotechnical Category 1 structure.

3 Objective

The objectives of this report are to:

- Provide information on the geotechnical and environmental quality of the ground present on the site with respect to the proposed development;
- Assess the potential health and other environmental risks posed by the site to the proposed development and to other specifically identified receptors; and
- Assess the potential for offsite contamination to adversely affect the proposed development.

4 Previous Studies

[1] BS EN 1997-1(2004)+A1:2013 Eurocode 7:Geotechnical Design: General Rules

The site has been the subject of previous investigations by LEAP others. The following site investigation reports have been supplied by the Client and the reader is referred to these earlier reports which should be read in conjunction with this report.

- Geophysical Survey Report, Bridge Farm Twyford by Magnitude Surveys report Ref. MSSU700 dated July 2020.
- BRE 365 Soakage Testing Letter Report, Bridge Farm Twyford by LEAP report Ref. LP2497/ST/1 dated April 2021.
- Phase 1 Ground Condition Assessment, Bridge Farm Twyford by Stantec Ltd report Ref. 332510718/3501 dated August 2021.

5 Scope of Works

This report describes a two stage process whereby the site is investigated and risks are assessed. The terms geotechnical and geoenvironmental are referred to throughout the report.

Geoenvironmental refers principally to the chemical nature of the ground and the degree of soil, water and/or land gas contamination and the impact that contamination may have on current or future development and also on the wider environment.

Geotechnical refers to all other aspects of the ground conditions and the impact they may have on the physical construction of existing or future development, principally foundations, slope stability, drainage, pavement and road design and groundwater control.

The investigation comprises two phases of work.

5.1 Phase 1 Scope

A Phase 1 Desk Study Report has been undertaken previously by others and was beyond the scope of these investigation works. As such the first part of this report presents a review of the previous reports pertaining to the site. The previous reports referred to are detailed above. In addition, the following publicly accessible sources of information[2] have also been reviewed:

- BGS '*Geology of Britain*' online viewer accessed on 10/05/23
- BGS Borehole log refs. SU77NE91, SU77NE92, SU77NE93, SU77NE94, SU77NE95, SU77NE106, SU77NE109 and SU77NE170

[2] The report contains British Geological Survey materials ©UKRI 2019 and public sector information licensed under the Open Government Licence v3.0.

- Defra 'MAGIC' website accessed on 10/05/23
- Groundsure.io website accessed on 10/05/23
- Unexploded WWII aerial delivered bomb (UXB) regional risk maps produced by Zetica

A site reconnaissance was carried out as part of the investigation works on the 11th and 12th of April. Current site users were interviewed and additional information was provided by the current landowner/occupier.

The desk study along with LEAP's own site reconnaissance have been used to develop a conceptual site model. The Desk Study report for the site was provided to LEAP after the scope of investigation had been agreed and as such the findings of this report did not specifically influence the investigation strategy. The initial site conceptual model is used to identify geotechnical and geoenvironmental hazards and the qualitative degree of risk associated with them. In terms of the geoenvironmental assessment the conceptual site model is used to identify potential sources of contamination, potential receptors and pathways by which the two may be connected. These are known as possible contaminant linkages and it is these contaminant linkages that are key to contaminated land risk assessment.

The Phase I investigation is also referred to as a Preliminary Investigation[3] .

5.2 Intrusive Investigation Scope

The Phase II work comprises intrusive investigation, onsite monitoring and laboratory analysis. The results of this and previous investigation reports are used to validate and/or update the initial site conceptual model. This phase of site investigation comprised the following tasks:

- 6 No. 4.0 – 5.0m deep windowless boreholes drilled with a tracked rig;
- 15 No. 1.8m – 3.2m deep machine excavated trial pits;
- In-situ geotechnical testing including Standard Penetrometer Tests in the boreholes and field vane tests in the trial pits (where appropriate soils were encountered);
- Geotechnical Laboratory Testing including Atterberg Limit Tests, Particle Size Distribution (PSD) Test, BRE SD1 Suite Tests and Saturation Moisture Content Tests;
- Chemical Laboratory tests including 12 No. LEAP standard soil suite tests and two pesticide screens.

[3] BS 10175:2011+A2:2017 Investigation of Potentially Contaminated Sites – Code of Practice.

The intrusive works were completed by contractors who have been scrutinised and are on LEAP's approved contractor list. The windowless sampling was carried out by Oakland Site Investigation Ltd, the machine excavated trial pits were carried out by Nicholls Plant Hire Ltd. Each excavation location was cleared for below ground services using Ground Penetrating Radar (GPR) and cable avoidance tools (CAT and Genny) and was positioned and levelled using GPS. All works were supervised by LEAP.

Selected samples of soil were scheduled for laboratory testing for a wide range of potential contaminants including metals, non-metals, polyaromatic hydrocarbons, pesticides and asbestos. The laboratory testing has been carried out by Envirolab.

Selected soil samples have been classified by laboratory analysis for geotechnical design purposes. The laboratory testing has been carried out by Geolabs Ltd at its laboratories in Watford.

The final stage in the geoenvironmental assessment comprises a quantitative risk assessment and revision of the preliminary Conceptual Site Model. Preliminary recommendations for remediation have been provided, based on various development assumptions which are detailed in the following section and in the text of this report. The risk assessment has been carried out in accordance with UK industry standards and in particular in accordance with LCRM[4] and BS10175:2011+A2:2017.

The final stage of the geotechnical assessment is the provision of preliminary soil parameters for use in geotechnical design, and broad recommendations for appropriate foundation options. It is intended that the Geotechnical Information section of this report will fulfil the general requirements of the Ground Investigation Report as set out in Section 6 of BS EN 1997-2:2007[5].

6 Sustainability Considerations

6.1 Carbon Reduction

There is an urgent need to optimise redevelopment to significantly reduce the carbon footprint of the process without compromising the requirement for delivering a safe and suitable use of the site. With that in mind, Leap has worked in partnership with the University of Surrey to develop a series of carbon reduction design tools (CReDiT). These provide

[4] Environment Agency. Land Contamination Risk Management (LCRM),. https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

[5] BS EN 1997 Eurocode 7- Geotechnical Design- Part 2: Ground Investigation and Testing (2007)

information on the embodied carbon cost of its report recommendations and encourage the conversation about carbon at an early stage in the design process.

Consideration has been taken throughout the report to align the recommendations with climate protection, circular economy and sustainable materials.

Leap recognises the unique position that it occupies at the very beginning of development projects and the value of informing clients on the carbon cost of design recommendations. As such, headline information from the CReDiT tools will be provided in site investigation reports without additional cost to the client. This is being done in order to engage furthermore detailed consultation where the full range of Leap's sustainability capabilities can be deployed.

6.2 Potential for Ground Source Heating and Cooling

Most locations in the UK are suitable for the installation of ground source heating or cooling (GSHC) systems. The most appropriate type of installation is determined by the available space, heating and cooling demands of the proposed development and a number of geological and hydrogeological factors, and drilling risks (amongst other factors). LEAP can appraise these site-specific conditions through a desk-based feasibility study to assist in determining the viability of this sustainable source of heating/cooling energy at the site, should this be of interest to you. We also have in-house capability to undertake field assessments including soil thermal conductivity surveys and soil thermal response test (TRT), as well as the design and installation of GSHC systems.

7 Limitations

This report has been prepared by Leap Environmental on the basis of information received from a variety of sources which Leap Environmental believes to be accurate. Nevertheless, Leap Environmental cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

Leap Environmental has used all reasonable skill, care and diligence in the design and execution of this report, taking into account the manpower and resources devoted to it in agreement with the Client. Although every reasonable effort has been made to obtain all relevant information, all potential contamination, environmental constraints or liabilities associated with the site may not necessarily have been revealed.

The conclusions reached in this report are necessarily restricted to those which can be determined from the information consulted and may be subject to amendment in the light of additional information becoming available. These conclusions may not be appropriate for alternative schemes.

This report is confidential to the Client and Leap Environmental accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known, unless

formally agreed by Leap Environmental beforehand. Any such party relies upon the report at their own risk.

Full details of the limitations are provided in Appendix A.

B ENVIRONMENTAL SETTING

8 Site Location and Description

The site is located to the northwest of the village of Twyford, Berkshire, to the south of New Bath Road, the east of the River Loddon and west of the Henley to Twyford railway line as shown in Figure 1, Appendix B.

The approximate National Grid Reference of the site is 478358, 176643 (SU783766). The site slopes gently towards the south and southwest from its highest point along its northern boundary (~39m AOD) to its lowest near the boundary with the river (~35m AOD).

8.1.1 General Description and Boundaries

A walkover survey was carried out on as part of the investigation on the 11th of April and photographs are included within Appendix C.

The majority of the site comprises open fields used for grazing livestock (cattle). The centre of the site is occupied by several cattle barns and concrete hardstanding and just to the north of this is a private house which is not within the development land.

The site is divided into four separate fields. The largest in the east of the site is separated from the others by a fence and Bridge Farm Road along with the cattle barns. The next largest, located in the northwest of the site is separated from those to its south by a row of mature deciduous trees. Mature trees were also present along the south section of Bridge Farm Road. The two largest fields were at the time of the investigation capped with cropped grass and despite recent rains were relatively firm underfoot. These fields were relatively level accept for in the southeast of the site adjacent to the trainline where a small area was notably lower compared to the surrounding field. Discussion with the landowner indicated that this was a "bomb hole" from WWII that was subsequently backfilled by the landowners father.

The two smaller fields in the south and southeast of the site (adjacent to the stream) were soft underfoot and the ground was uneven. Furthermore, plants indicative of wet conditions were present in this area.

The central area comprised concrete hardstanding and several farm buildings and was still in use at the time of the investigation with the barns occupied by cattle. The area was capped with concrete hardstanding and vehicles including a tractor, lorry and a caravan were being stored in this area. The existing structures were relatively dilapidated and included some corrugated cement sheeting which may potentially contain asbestos. Two large silos are present in this area and a small generator as well as some oil/fuel drums were noted adjacent to one of the structures.

Several services were noted to be present on site. Two sewers are present in the southern fields of the site following a southeast-northwest alignment before doglegging in the south and

exiting the site through its eastern boundary. BT and high voltage electrical cables are present following the alignment of Bridge Farm Road, through the centre of the site. Discussions with the landowner indicated that a private water pipe also runs along the alignment of this road and that a sewer (the exact location of which is not known) runs from the house near the centre of the site westwards.

The site is bounded by New Bath Road to the north, the Henley to Twyford rail line to the East, fields woodland and a children's nursery to the south and the River Loddon to the West.

8.2 Geology

The geology of the site has been ascertained by reference to the BGS website (www.bgs.ac.uk). The site is mapped as being underlain by the Kempton Park Gravel Member over the Undifferentiated Seaford and Newhaven Chalk Formations of the White Chalk Subgroup. Alluvium is mapped extending onto the far southwest of the site only.

8.2.1 Alluvium

Alluvium is a recent deposit laid down by rivers. In the Thames Valley it forms a flat surface in the Valley floor and generally it lies unconformable on river terrace gravel.

Alluvium consists largely of silty clay and clayey silt with locally developed beds of fine to coarse grained sand mainly less than 1m thick. Alluvium can present several problems for construction. Rapid lateral transitions in soil type are to be expected. Running sands are common. The clays and silts in particular are weak and highly compressible.

8.2.2 Kempton Park Gravels

Kempton Park Gravels are part of the former Flood Plain Gravel which is the youngest of the three River Terrace Gravels that were laid down by the Thames. The river terrace deposits consist of variable proportions of sand and gravel. They were deposited in a braided river system, an estimated 5km wide. Gravel dominated beds, generally less than 2m thick are cut through by broad shallow channels which are in-filled with tabular cross bedded gravelly sand in fining upward sequences. There are also impersistent beds of clayey and silty fine sand which are generally less than 1m thick.

8.2.3 White Chalk Subgroup

The White Chalk Subgroup (Seaford and Newhaven Chalk Formations) is a very fine grained white limestone consisting predominantly of the disaggregated skeletal remains of tiny planktonic algae, and is composed of almost pure calcium carbonate. Layers of flint are common within the White Chalk Subgroup. Flint is composed of silica derived from the dissolved skeletons of siliceous sponges and microfossils.

Chalk is particularly affected by weathering and the effects of dissolution. The top surface of the chalk is usually irregular and may be include deep drift filled solution pipes for example. Chalk is also susceptible to frost action.

8.2.4 BGS Boreholes

The online BGS Geoindex (http://www.bgs.ac.uk/geoindex/) has been reviewed for detailed local geological and hydrogeological information. Nine boreholes have been identified within 150m of the site boundary. Eight of these are located to the north of the site (beyond New Bath Road) the other is located to the immediate south of the site in the area of the childrens nursery. The following historical borehole logs have been reviewed.:

- SU77NE91 located 50m to the north.
- SU77NE92 located 40m to the north.
- SU77NE93 located 75m to the north.
- SU77NE94 located 100m to the north.
- SU77NE95 located 85m to the north.
- SU77NE106 located 140m to the northwest.
- SU77NE109 located 60m to the northwest.
- SU77NE170 located 70m to the south.

The logs generally indicate that the ground conditions comprise sands and gravels with variable proportions of clay to between 1.6m and 5.6m bgl over chalk which is indicated to have been recovered as "clay". The logs generally report that the boreholes were dry although one notes that soils encountered were damp at 3.0m bgl.

8.2.5 Solution Features

Solution features generally occur where preferential weathering of the chalk occurs along discontinuities or joints. They are more common along geological boundaries, where surface water runoff from impermeable soils meets the more permeable underlying chalk. It is noted that solution features are particularly prevalent near the boundary between the Chalk and the Lambeth Group due to acidic rainwater percolating through these more acidic overlaying deposits into the chalk. Solution features are generally infilled with loose/soft soils, and can be visible at ground level due to surface depressions, although this may be masked by overlying superficial deposits. They may lie dormant for many years, and are generally reactivated by the introduction of water from, for example, a leaking drain, soakaway etc.

8.3 Hydrogeology

Table 1: Hydrogeology

Superficial Deposit	Alluvium	Secondary A Aquifer
	Kempton Park Gravel	Secondary A Aquifer
Bedrock	White Chalk Subgroup	Principal Aquifer
Source Protection Zone	Zone 2	

The hydrogeology of the site has been ascertained from the Groundsure.IO and Defra.Magic websites. The source of the data is reported to be the Environment Agency groundwater vulnerability mapping.

The superficial Alluvium and Kempton Park Gravel deposits which are mapped beneath the site are classified as a Secondary A aquifer whilst the underlying Chalk is classed as a Principal Aquifer.

The site is situated within an outer (Zone 2) of a Groundwater Source Protection Zone (SPZ).

8.4 Hydrology

The River Loddon bounds the site's west and south western boundary.

8.5 Flooding

According to the Environment Agency sections of the site are located with a flood risk zone. Flood Zones 2 and 3 extend across much of the south and south western sections of the site close to the river.

A zone 2 floodplain estimates the annual probability of flooding as one in one thousand (0.1%) or greater from rivers and the sea but less than 1% from rivers or 0.5% from the sea.

A zone 3 floodplain estimates the annual probability of flooding as one in one hundred (1%) or greater from rivers and a one in two hundred (0.5%) or greater from the sea.

8.6 Unexploded Ordnance (UXO)

The risks from unexploded ordnance have been assessed in accordance with CIRIA guidance[6]. A non-UXO specialist preliminary screening assessment has been carried out. The risks have been assessed by considering firstly the likelihood of military activities on, or in the vicinity of the site as determined from the desk study and historical review. Secondly the risk of UXO has been assessed by reference to the unexploded WWII aerial delivered bomb (UXB) regional risk maps produced by Zetica.

The Zetica risk maps indicate a low risk. Hence the overall risk of UXO was rated as low. However, it is noted discussions with the current landowner after the investigation indicated that the south east gravel pit was a "bomb hole", that had been filled in by his father. No information pertaining to this has been provided to Leap from the client or in the desk study.

It is recommended that a detailed UXO risk assessment be undertaken prior to any further intrusive works being undertaken on site.

[6] CIRIA C681 2009. Unexploded ordnance (UXO) - A guide for the construction industry

8.7 Radon

The previous Stantec Desk Study report for the site indicates that the site is situated within an area where 1% to 3% of properties are above the action level and as such radon protection measures are not required. However, it is noted that this report is dated August 2021.

The UK Health Security Agency (UKHSA) and British Geological Survey (BGS) updated the UK Radon maps in December 2022. The freely available 1km grid square radon mapping has been reviewed which indicates that the site is situated within an area where 5% to 10% of properties are above the action level. In England basic protection measures are required where greater than 3% are above the action level. Based on the information above basic radon protection is required on site.

However, we would note that a detailed radon risk map 25-50m grid spacing can be sourced which may indicate that only sections of the site rather than the whole site are impacted.

9 Previous Investigations

The site has been the subject of 3 No. reports undertaken by LEAP and others, the relevant findings of which are summarised below where they have not previously been outlined above.

9.1 Geophysical Survey Report by Magnitude Surveys

The report presents the findings of magnetic geophysical survey undertaken across the site. The Investigation was undertaken to examine the potential presence and extent of archaeological materials on site. However, evidence for potential variations in ground make up were also identified and discussed. For simplicity only information pertaining to the make of the natural and anthropogenic soils on site are summarised hereafter.

The report makes reference to a magnetic anomaly which is aligned broadly east to west across the centre of the eastern field of the site. The report indicates that the anomalies encountered are indicative of ferrous material within the topsoil. It goes on to note that the location and orientation broadly corresponds to a form field boundary fence.

The report notes the presence of two large anomalies located near the eastern and western boundaries of the eastern field. The report notes that that the locations correspond to the location of two former gravel pits and that the anomalies are indicative of rubble type infill materials.

The report also highlights that long sinuous anomalous bands were recorded across much of the site except the area adjacent to the river. The report posits that the bands related to variation in the gravel and sand superficial deposits due to variations in their fluvial deposition. It goes on to note that no such features were recorded in the southwest of the site adjacent to the river, where alluvial soils are mapped.

9.2 LP2497 BRE 365 Soakage Testing by LEAP

The report presents the findings of an investigation undertaken in March 2021. The investigation was undertaken as specified by the client and comprised five machine excavated trial pits to depths of between 2.4m and 3.1m.

The ground conditions encountered generally comprised between 0.2m and 0.3m of topsoil over interbedded sandy clays, sands and gravels to depths of between 1.6m and over 3.1m bgl. Three locations TP03, TP04 and TP05 all situated in the south of the site encountered structureless grade Dm Chalk underlying the superficial deposits. Rapid groundwater seepages were encountered in TP04 and TP05 at 2.0m and 2.5m bgl respectively. A slight seepage was also encountered in TP03. Perth penetrometer tests were undertaken in each of the trial pits. Perth blow counts recorded in the clays ranged from 15 to 16 while those recorded in the sands and gravels ranged from 5 to 15.

Soakage testing in full accordance with BRE365 guidance was undertaken in each trial pit. The test results ranged from 16.45 l/m^2/min to 0.62 l/m^2/min. The highest infiltration rates were recorded in TP01 with the lowest recorded in TP05.

The report noted that a desk study for the site had not been provided to LEAP by the client and that geotechnical testing was beyond the scope of works. As such it was indicated that at this stage the chalk on site was assumed to be of low density and therefore in accordance with CIRIA C574 any soakaways should be situated at least 10m any foundations. It goes on to note that should the site be found to in an area at risk of solution features then this offset should increase to 20m, and that confirmatory testing of the chalk density should be undertaken.

The report also outlined that given the rapid seepages encountered shallow groundwater may be present on site and as such storage within any proposed soakaways was likely to be limited. Groundwater monitoring throughout the winter in the areas of the soakaways was recommended to confirm groundwater levels.

9.3 Phase I Desk Study Twyford Bridge by Stantec

A Phase 1 Desk Study for the site was compiled by Stantec in August 2021. The report highlights that much of the site is underlain by the Kempton Park Gravel over the Chalk at depth except in the south and west where Alluvium is mapped at surface. It noted that two infilled gravel pits are present on site and that made ground should be anticipated in these areas. It also notes that the site is located within a nitrate vulnerable zone.

A walkover survey completed as part of the investigation noted that much of the stie was occupied by open fields. The centre of the site was occupied by farm buildings some of which were in a poor state of repair. Corrugated cement which potentially contains asbestos was noted within the structure of these buildings. Two silos as well a storage of vehicles was also noted in this area.

It goes on to summarise that the site had been mapped as fields since 1872. Two "old gravel pits" were mapped on site in 1912. By 1930 New Bath Road was mapped to the north of the site. The report notes that the area surrounding the site comprised a train line, horticultural nurseries, off site clay and gravel pits and an off site transformer station.

Two historical offsite landfills were reported 155m to the northwest and 220m to the east. No information on the northwestern landfill was available, the eastern landfill was active from 1950 to 1959 for disposal of inert house hold and commercial waste.

The geotechnical risk assessment for the site indicated that the potential risk associated with shrink swell of soils and running sands is low to moderate. The potential risk associated with solution features within the underlying chalk was classified as moderate. The risk associated with compressible ground was classified as low across the majority of the site although it was noted that compressible soils may be present in the area mapped as alluvium.

Potential onsite contaminants of concern associated with the sources identified above were considered to be pesticides, petroleum and polycyclic aromatic hydrocarbons, metals and asbestos. The risks to future site users, construction workers and controlled water receptors were generally classified as very low increasing to moderate in localised areas of the site (infilled pits and farm yard area).

C PRELIMINARY RISK ASSESSMENT

10 Preliminary Geoenvironmental Conceptual Site Model

10.1 Approach

A risk based approach is used in the UK to assess contaminated or potentially contaminated land. For a potential risk to exist, there must be a contaminant linkage in place, i.e. there must be a source of contamination, a potential receptor, and a pathway linking the two. The purpose of this preliminary conceptual site model (CSM) was to systematically identify all of the potential contaminant linkages using the information provided in Section B of this report. The preliminary CSM was then used to enable uncertainties and further assessment requirements to be identified.

10.2 Potential Sources of Contamination

Based on a review of the available information discussed in Section B of this report Table 2 provides a summary of the potential plausible current and historical on- and off-site sources with the anticipated nature and distribution of the sources:

Table 2: Potential Plausible Sources of Contamination

Potential Source	Potential Contaminants of Concern	Anticipated Distribution
On-Site		
Infilled Pits	Metals, Petroleum and Polycyclic Aromatic Hydrocarbons (PHC & PAH), Asbestos and Ground Gases.	Two infilled pits in the eastern section of the site.
Agricultural Activities	Pesticides, metals and petroleum hydrocarbons.	Diffuse across the site.
Existing buildings and material storage.	Metals, PHC, PAH and asbestos.	Centre of the site around the farm buildings.
Off-Site		
Offsite historical landfills	Ground Gases (Carbon Dioxide and Methane).	
Offsite electrical transformer	Polychlorinated biphenyls (PCB)	

The two historical gravel pits mapped are no longer visible on site and have therefore been backfilled at some point during its history. The nature of the backfill material is unknown but presents a potential source of contaminants including, metals, hydrocarbons compounds, asbestos and, if degradable material is present, ground gases.

The central area of the site is currently occupied by barns, auxiliary buildings and concrete hardstanding along with some vehicle storage. The site activities in this area present a potential risk of metals and hydrocarbons within the soils beneath and surrounding the structures along with potential asbestos contamination associated with the building structure itself.

Given the site's agricultural use the use of pesticides across the site at some point in its history is likely. Furthermore, heavy metal laden sewage was occasionally used as a fertiliser historically and as such the presence of metals within the shallow soils cannot be discounted. There is the potential for minor fuel spillage/leakages from agricultural vehicles to have occurred on site although it is noted that any such contamination if present would likely be minor and localised.

10.3 Potential Receptors

In the context of the proposed future land use, the following potential receptors of ground contamination were identified:

Human Health

- Future residents
- Construction workers

Controlled Waters

- Superficial Secondary A Aquifer - Kempton Park Gravel
- Bedrock Principal Aquifer Chalk
- River Loddon adjacent to the site boundary.

Other

- Material construction of buildings and infrastructure
- Neighbouring properties

10.4 Potential Contaminant Linkages

The potential plausible contaminant linkages are summarised in the table appended in Appendix D and were assigned a qualitative risk classification in line with the guidance presented in Annex 4 of R&D66. The preliminary risk levels were determined following a review of the available desk-based information with the significance of particular contaminant linkages being dependant both upon the likelihood of exposure occurring and the severity of that exposure.

10.4.1 Human Health

The proposed development comprises residential housing with private gardens and public open space. Therefore, all the generic Contaminated Land Exposure Assessment (CLEA)[7] exposure linkages between humans and potential contaminants in the ground are plausible i.e. direct ingestion of soil, ingestion of homegrown produce, and inhalation of indoor and outdoor vapours and dusts. Groundworkers could be potentially exposed via all these pathways, except for those involving edible plants. However, due to the low likelihood for high concentrations of contaminants to be present on-site, the potential for unacceptable risks to human health via these pathways is considered to be low.

The assessment of future on-site users is considered to be protective of the surrounding off-site residents and off-site commercial workers.

10.4.2 Ground Gases

There is potential for ground gases derived from the degradation of organic substances associated with infilling of the two onsite gravel pits. These gases can build up in confined spaces within building structures and be released particularly during significant falling and low pressure atmospheric conditions. Carbon dioxide can cause asphyxia and methane can cause explosions. A review of the historical maps included within the previous desk study indicates that the pits were present on site between 1910 and at least 1956. Given the relatively limited size of the pits and the age of backfilling (circa 1950s) it is considered that these infilled pits do present an albeit minor risk of gas generation with the potential to impact the development. Given the granular nature of the superficial soils there is the potential for gases generated to migrate both vertically and laterally through the ground on site.

10.4.3 Controlled Waters

The site is underlain by both a Secondary A and Principal Aquifer (Kempton Park Gravels and White Chalk) with shallow groundwater seepages noted during previous works at between 2.0m and 2.5m bgl in the south and southwest of the site. Based on the findings of the previous trial pits it is considered that the two aquifers are in hydraulic connectivity with one and other. The site is situated within a Outer Zone (Zone 2) of a Groundwater Source Protection Zone.

Based on the above there is the potential that any contaminants present within the shallow soils or within the infilled gravel pits could impact the underlying aquifer.

10.5 Summary of Geo-Environmental Preliminary Risk Assessment

The majority of the site has been open fields since the earliest available historical maps. However, two former gravel pits were present in the east of the site which have since been backfilled and the centre of the site is occupied by a farmyard. Shallow made ground should

[7] Environment Agency 'Updated technical background to the CLEA model' Science Report: SC050021/SR3. January 2009.

be anticipated in the farmyard area and deeper made ground in the area of the former pits. The made ground represents a potential source of common contaminants including metals, and PAH compounds.

Given the site's agricultural use it is likely that pesticides have been used across the site at some point in it history and these may still be present within the shallow soils.

Farm vehicles are currently stored in the farmyard area and presumable have been used across the wider site. Therefore, there is the potential that fuel spills/ leakage has occurred on site. However, it is noted that these would likely be minor and localised.

The risk to future site users from the contaminants outlined above is generally classified as low increasing to moderate in the area of the pits and the farmyard.

The deep made ground (if present) represents a potential source of ground gases if found to contain high proportions of degradable material. Given the generally granular nature of the natural soils on site there is the potential for any gases generated to migrate both vertically and laterally through the subsurface. Given the size of the gravel pits, overall the risk from ground gas has been assessed as low.

Made ground may also be a source of asbestos contamination, and potential ACM was identified in the farm buildings. Asbestos is also often present beneath areas of hardstanding on farmland. Overall the risk from asbestos on site is considered low, but increases to high in the areas of made ground and around the farm buildings, due to the potential severity from exposure.

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The risk to construction workers is classified as low assuming that site hygiene is well maintained, and the correct PPE is in use.

The risk to controlled water receptors is classified a low to moderate due to the sites position adjacent to the River Loddon, and overlying a Secondary A and Principal Aquifer within a groundwater source protection zone.

11 Geotechnical Risk Assessment

11.1 Preliminary Ground Model

Based on the findings of the desk study, the preliminary ground model for the site is summarised in Table 3 below.

Table 3: Preliminary Ground Model

Ground Model	Characteristics	Notes

Ground Conditions	Made Ground	Deep made ground is likely to be present in the former pits with shallow made ground also likely in the farm yard area. Made Ground is by nature highly variable and is generally not suitable as a load bearing stratum. Large obstructions may potentially be present dependent on the nature of the pit infill.
	Superficial: Alluvium	Alluvial soils are generally poorly consolidated and can variably comprise both cohesive and coarse-grained strata. Alluvium often contains variable quantities of organic materials.
	Superficial: Kempton Park Gravel	The Kempton Park Gravel predominantly comprises channelised sandy gravels and gravelly sand with occasionally lenses of silts and clays.
	Bedrock: White Chalk Subgroup.	The White Chalk general exhibits an irregular upper surface which has weathered to gravelly silts. The Chalk can be associated with solutions features which are often infilled with loose superficial deposits.
Groundwater	Groundwater seepages were noted at between 2.0 and 2.5m bgl within the previous pits completed on site. The site is underlain by the Chalk aquifer overlain by the Gravel Superficial aquifer. Given the relatively low-lying nature of the site and the presence of the River Loddon adjacent to the south west boundary shallow groundwater within the gravels on site are to be anticipated.	
Surface Water features	River Loddon situated along the site's western boundary and given the topography of the site any surface water running from the site is likely to drain into the River.	
Topography	The site slopes gently downwards to the southwest from its highest point in the northeast with a level change of ~6m between its highest and lowest points.	
Existing Structures	Concrete hardstanding and farm buildings are currently present in the centre and foundations should be anticipated in this area. No deep excavations or chambers were observed during the walkover although some manhole covers which could not be lifted were noted. Two sewers are present in the western half of the site and several manhole covers associated with these are present in the fields adjacent to the river.	

11.2 Geotechnical Risk Register

In order to establish the minimum requirements for geotechnical investigations, designs and post construction monitoring, it is necessary to establish the complexity of the geotechnical design and the associated risks.

The preliminary geotechnical risk register for the proposed development is summarised in the table in Appendix E. Details of the risk assessment methodology are presented in Appendix E.

11.3 Summary of Preliminary Geotechnical Risk Register

The following geotechnical hazards have been identified:

The site is underlain by a superficial and bedrock aquifer and is situated adjacent to the River Loddon. Previous trial holes excavated on site encountered shallow groundwater seepages at between 2.0 and 2.5m bgl during the spring of 2021. As such shallow groundwater should be anticipated on site. Running sands / gravels should be anticipated where excavations extend below the water table. Should deep excavations be proposed on site allowance for dewatering should be in place.

Two former gravel pits are present on site which have been backfilled. The nature of the infill material is unknown however, it is unlikely to be suitable as a load bearing stratum and foundations will likely require deepening to natural soils at depth. Furthermore, excavations within the made ground are likely to be unstable even in the short term. Excavations in the granular natural soils will be unstable and subject to collapse.

The site is underlain by Superficial deposits over the Chalk at depth. The boundary between the Kempton Park Gravel and Alluvium is present on site and the boundary with the Lambeth Group is mapped ~400m to the east and south of the site. Solution features are more prevalent near geological boundaries as such their the potential for the upper portion of the chalk to be highly weathered and solutions features if present may be infilled with poorly consolidated sediments.

The natural soils across the majority of the site are not considered to be excessively compressible. Although it is noted that should evidence for solution features be present these may be infilled with compressible material. The southwest of the site is mapped as being underlain by Alluvium, these soils are likely to be compressible although it is noted that no development is proposed in this portion of the site. As such settlement is not considered to pose a significant risk. However, should the development layout change or alluvial soils be encountered within the developable portion of the site then this conclusion would require reassessment.

The underlying natural soils are anticipated to predominantly comprise granular strata. However, localised cohesive soils may be anticipated. These are not anticipated to exhibit high plasticity however some foundation deepening may still be required should cohesive soils be encountered near trees.

On the basis of the initial review and preliminary risk assessment, the site is given a Geotechnical Classification of **Geotechnical Category 1** in accordance with EN1997-1 §2.1(14)-(21).

12 Sustainability Considerations

The geological, geotechnical and hydrological conditions of the site along with the potential for contamination can significantly influence the suitability of sustainable options on site.

The mapped ground conditions indicate predominantly granular near surface deposits. However, given the interbedded nature of the soils the potential for cohesive soils on site which may require the need for some deepening cannot be discounted. Furthermore, the site is underlain by Chalk and as such there exists the potential for solution features to be present with the upper weathered chalk. As such a piled foundation may be the less carbon intensive option in at least some sections of the site.

The conceptual site model has indicated a generally low risk of contamination on site outside of the areas of the farmyard and infilled pits. As such it is anticipated subject to testing that the soils will be suitable for reuse on site and caution should be taken to limit the disturbance of natural soils. In particular, where areas are to be retained as open green space then where possible disturbance of the topsoil should be avoided.

D PHASE II - INTRUSIVE INVESTIGATION

13 Investigation Rationale

The key objective of the intrusive investigation was to aid the design and construction of the proposed development plan (Figure 2) and to determine any constraints associated with ground contamination and foundation design.

To achieve the investigation rationale, the scope of works comprised a total of 21 No. investigation locations across the site: 15 No. machine excavated trial pits to a maximum depth of around 3.0m and 6 No. windowless sampler boreholes to depths of between 4.0m and 5.0m.

The scope of the investigation was non-targeted to give general coverage across the greenfield portion of the site and, in accordance with BS10175, took into consideration the proposed development plans and the preliminary geoenvironmental and geotechnical risk assessments that were developed in Section C. The farmyard area at the centre of the site was still in use at the time of the investigation for livestock storage and vehicles were accessing the area through the works. As such investigation in this area of the site was not undertaken as part of the investigation.

The investigation locations were located to provide general coverage and preliminary information on the ground conditions on site. At this preliminary stage the location spacings do not meet the requirements of BS8004:2015+A1:2020[8] Clause 4.2.1.1 for low rise buildings and further investigation will be required for the detailed design stage.

The spacing of the investigation locations across the development area of the site was generally consistent with the recommended density of 25 to 50m for an exploratory investigation after BS10175 Section 7.7.

Due to the potential for ground gases as well as to assess the groundwater regime on site monitoring wells were installed in four of the windowless sampler boreholes (namely WS101, WS103, WS105 and WS106).

The site investigation locations undertaken along with the location of the five previous soakage test pits are provided in Figure 3, Appendix B and Table 4 provides a summary of the rationale, proposed scope and what was achieved in the field:

Table 4 Rationale and Scope for Investigation Locations

[8] BS 8004:2015+A1:2020 Code of Practice for foundations

Trial Hole	Rationale	Proposed Depth (m bgl)	Achieved Depth (m bgl)	Additional Comments
WS1 – WS6	Provide information on the ground conditions and enable sampling for chemical and geotechnical testing. Provide a location for monitoring well installation.	4.0	4.0 – 5.0	WS101 was extended to 5.0m bgl due to highly weathered chalk encountered at 4.0m bgl.
TP101 – TP116	Provide information on the ground conditions and a location for geotechnical and geo-environmental sampling.	3.0	1.80 – 3.20	Some trial holes were terminated at shallow depths due to pit instability.
TP106 & TP111	Provide information on the ground conditions within the area of the former gravel pits.	3.0	2.30 – 3.15	TP111 terminated due to pit instability.

14 Site Work

14.1 Date and Weather Conditions

The intrusive investigations were undertaken in a single phase between the 11th and 12th of April 2023. At the time of the investigations, the weather was dry and bright.

The Met Office Climate Summaries have been reviewed for rainfall information pertaining to the three months prior to the site works. The climate summaries indicate that January 2023 experienced broadly average rainfall while February was much drier than average experiencing <20% of average monthly precipitation. Conversely March was wetter than average with the UK as a whole experiencing 155% of average monthly rainfall and southern areas over double the average rainfall was recorded.

14.2 Site Work Methods

14.2.1 Windowless Sampler

The Windowless sampling rig consists of a tracked barrow with a sampling unit mounted on the top. When in the required position, the mast was raised to a height allowing a mechanised drop weight to fall repeatedly onto an anvil, and drive attached sample tubes or probe rods into the ground to produce reasonably intact continuous samples which were then extracted using the integrated hydraulic ram.

To reduce any tendency of the tubes to stick in the ground, a succession of smaller diameters may be used to obtain full depth. Excavated soils were placed aside for inspection and sampling.

On completion the trial hole was backfilled with excavated material, placed in reverse order, and the surface reinstated unless otherwise specified.

14.2.2 Trial Pitting

Trial pits were dug by a backhoe excavator. The trial pits had a target depth of 3m bgl and were typically 0.6m wide by 2.0m long. Trial pit logs are included as Appendix E. Spoil was replaced in reverse order. Trial pits were left mounded to allow for future settlement.

14.2.3 Soil Logging and Sampling

Soil samples were recovered from the boreholes and trial pits for field screening, logging and sampling.

Boreholes and trial pits were logged in general accordance with the requirements of BS 5930:[9] and BS EN ISO 14688[10]. Borehole logs are presented in Appendix E.

Visual and olfactory evidence of contamination was noted if encountered. These observations were used to aid scheduling of samples for chemical laboratory analyses, and are included on the borehole logs in Appendix E and summarised in Section 15.3.2.

Samples were collected by hand (using dedicated nitrile gloves for each sampling location). Samples were placed into laboratory supplied sampling containers, specific to the type of analyses required.

All sample containers were sealed and labelled with a unique location identity, depth and date of sampling.

14.2.4 Monitoring Well Installation

Four monitoring wells were installed during this investigation within the windowless sample boreholes. The monitoring wells were constructed of 50mm diameter HDPE pipe. The response zone was typically targeted to intercept the groundwater surface and was surrounded by washed filter gravel. The plain zone was surrounded with bentonite to provide a seal. The monitoring wells were finished with bungs with gas taps and raised steel covers. Monitoring well installations are shown on the borehole logs and summarised in the following table.

[9] BS5930:2015+A1:2020 Code of Practice for Ground Investigation

[10] BS EN ISO 14688 Parts 1-2 (2018) Geotechnical Investigation and Testing. Identification and classification of soil

Table 5: Borehole installation details

Borehole	Targeted Medium	Installed Depth (m bgl)	Response Zone (m bgl)	Bentonite Seal (m bgl)	Targeted Stratum
WS101	Groundwater	3.0	1.0 – 3.0	0.1 – 1.0	Kempton Park Gravel and Chalk
WS103	Groundwater	3.0	1.0 – 3.0	0.1 – 1.0	Kempton Park Gravel
WS105	Groundwater	3.0	1.0 – 3.0	0.1 – 1.0	Kempton Park Gravel and Chalk
WS106	Groundwater	3.0	1.0 – 3.0	0.1 – 1.0	Kempton Park Gravel and Chalk

14.3 Sampling and Field Tests

14.3.1 Soil Sampling

Geoenvironmental soil samples were selected to ensure that near-surface exposure of human health via direct contact was targeted, as well as to spatially and vertically delineate possible sources of contamination.

Geotechnical soil samples were targeted to characterise the geological sequence, and to obtain characteristic soils properties and specific geotechnical design parameters as per the proposed development.

14.3.2 Standard Penetration Tests

Standard penetration tests were undertaken in the boreholes at 1.0m centres, in accordance with BS EN ISO 22476-3;2005. Uncorrected blow counts, 'N values', are recorded on the borehole logs in Appendix E.

14.3.3 Field Vane Test

In-situ field vane tests were undertaken in cohesive soils in the trial pits in accordance with BS EN ISO 22476-9 (Draft). The results are recorded on the trial pits logs in Appendix E.

14.4 Ground Gas and Groundwater Monitoring

Four groundwater monitoring wells were installed to enable a preliminary assessment of the groundwater regime across the site. The wells were located to provide a general coverage. Three preliminary rounds of groundwater level monitoring were undertaken between April and May 2023.

Due to made ground being encountered during investigation the wells were also monitored for ground gases on two occasions although it is noted that none of the wells were situated within the made ground.

14.4.1 Ground Gas Monitoring

The site is predominantly underlain by the Kempton Park Gravel Member over the Chalk at depth. However, two infilled gravel pits were previously mapped on site, they were mapped on site from circa 1910 to circa 1970. The pits are located in the east of the site, the smaller of the two was ~15m in diameter while the large was around 35m in its longer dimension. Furthermore, Alluvium is mapped in the southwest of the site. Based on BS8576:2013[11] the Alluvium mapped on site classified as a very low risk gas source while the infilled pits are classified as a low risk due to their relatively small size. The proposed residential development is classified as a high sensitivity receptor.

BS8576:2013 indicates that for the following conditions:

- Onsite Alluvium (very low gas generation potential).
- Onsite infilled gravel pits dating pre-1970 (Low gas generation potential).
- Granular soils (Kempton Park Gravel (plausible gas migration pathway); and,
- High sensitivity receptor (residential properties with gardens).

That monitoring over a two-month period with up to weekly monitoring visits is recommended. Gas monitoring was beyond the scope of these works but to provide a preliminary assessment the gas concentrations were recorded on two occasions within the groundwater monitoring wells installed.

The visits were completed on 18/04/23 and 04/05/23. The wells were monitored for methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide using a GFM 436 portable gas analyser.

14.5 Laboratory Analysis

14.5.1 Geotechnical Laboratory Testing

Selected samples of the soils have been classified by laboratory analysis for geotechnical design purposes. The laboratory testing has been carried out by Geolabs Ltd at its laboratories in Watford, in accordance with BS1377[12] and BS EN ISO17892[13]. The sampling technique, type,

[11] BS8576:2013 Guidance on investigations for ground gas. Permanent gases and Volatile Organic Compounds ()

[12] BS1377 Parts 1-9:1990 Methods of test for Soils for Civil Engineering Purposes

[13] BS EN ISO 17892 Parts 1-12 Geotechnical Investigation and Testing. Laboratory testing of soil

storage and transport and the number of laboratory tests have been undertaken where possible in accordance with BS EN 1997-2:2007 and BS EN ISO 22475[14].

The following laboratory tests have been undertaken:-

Table 6 Geotechnical Laboratory Testing

Test	Number of tests			
	Kempton Park Gravel			Chalk
	Clay	Sand	Gravel	
Moisture Content	2	-	-	-
Atterberg Limit Test	2	-	-	-
Particle Size Distribution Test	-	1	3	
Saturated Moisture Content	-	-	-	3*
BRE SD1 Suite A	-	1	1	-
BRE SD1 Suite B	3	-	-	-

*Two further tests scheduled but tests could not be completed due to the highly weathered quality of the Chalk.

The geotechnical laboratory test results are provided in Appendix I.

14.5.2 Chemical Soil Analysis

Selected samples of soil were subjected to laboratory testing.

The suite of soil contaminant analysis took into account the potential contaminants of concern identified in the CSM (heavy metals, PAHs, asbestos and pesticides). Soil samples were also analysed for pH and total organic carbon (TOC) to support the selection of assessment criteria in the subsequent quantitative risk assessment (QRA) for human health.

Sampling techniques and storage have been undertaken as per BS 10175:2011+A1:2013 Code of Practice for Investigation of Potentially Contaminated Sites. The laboratory testing was carried out by Envirolab. Where available, the tests for soils procedures were UKAS and MCERTS accredited.

The following analyses were completed on selected soil samples based on field observations and for general vertical and lateral coverage:

[14] BS EN ISO 22475 Parts1-3 Geotechnical Investigation and Testing. Sampling methods and groundwater measurements

- 12 No. metals (As, Cd, Cr, CrVI, Cu, Pb, Hg, Ni, Se, Zn)
- 12 No. USEPA 16 PAHs
- 12 No. Asbestos identification
- 2 No. organochlorine and organophosphorus pesticide suites.
- 2 No. Triazine herbicides suites
- 12 No. pH
- 12 No. TOC

The laboratory test results are summarised in Section G and Appendix J, and the laboratory analytical certificates are provided in Appendix K.

14.6 Constraints to the Scope

Access was available to the majority of the site at the time of the investigation. However, the central farmyard area was still in use and was occupied by livestock at the time of the works. As such investigation in this area of the site was not possible and further investigation and chemical testing in this area following site clearance would be required.

15 Ground Conditions

The ground conditions encountered across the site varied between the areas mapped as being underlain by the gravels (the development area) and those underlain by Alluvium (the public open space). As such the ground conditions encountered in these two areas are summarised separately below. The ground conditions encountered within the two infilled pits are also summarised separately for clarity. Trial hole logs for each excavation are attached in Appendix E. In summary the soil conditions were as follows:

15.1 Development Area

Table 7: Summary of soils encountered across the development area (excluding the gravel pits).

Depth From (m)	Depth To (m)	Soil Type	Description
0.0	0.20 / 0.40	**TOPSOIL**	Brown slightly gravelly silty sandy TOPSOIL with abundant rootlets. Gravel is medium to coarse subrounded to rounded occasionally angular flint. (Appeared reworked in TP102 and WS106 only)
0.20 / 0.30	0.45 / 0.90	**SUBSOIL**	Brown to orange brown slightly gravelly sandy clay and clayey sand SUBSOIL. Gravel is medium to coarse occasionally cobble sized sub-rounded to rounded flint. (Appeared reworked in TP102 only)

0.45 / 0.90	0.80 / 4.00*	**SAND, GRAVEL & CLAY**	Interbedded: Medium dense orange brown to light brown occasionally mottled off white slightly clayey slightly sandy GRAVEL. Gravel is medium to coarse occasionally cobble sized subrounded flint. AND Medium dense locally loose brown to orange brown slightly gravelly occasionally slightly clayey silty fine SAND. Gravel is fine to coarse occasionally cobble sized flint. AND Soft to firm occasionally stiff brown to orange brown occasionally thinly laminated slightly sandy to sandy slightly gravelly CLAY. Gravel is fine to coarse subrounded flint and occasional fine chalk.
0.80 / 2.90	1.60 / 4.0*	**SILT** **(Chalk Head)**	White to off white mottled brown gravelly SILT with pockets of brown sandy clay. gravel is medium to coarse subrounded flint and fine to medium chalk. (Encountered in TP108, TP112 and WS104 only).
1.2 / 2.0**	1.8* / 5.0*	**CHALK**	Off white highly weathered variably grade Dc and Dm CHALK with occasional medium to cobble sized flint recovered as silty gravel. (Encountered in WS101, WS103, WS104 WS105, WS106 TP03, TP110, TP112, TP113, TP114)

*full depth of investigation

**where encountered

The majority of the development area of the site is underlain by silty sandy topsoil of between 0.2m and 0.4m thick over clayey sand and sandy clay subsoils to between 0.45m and 0.9m bgl. The topsoil was noted to appear reworked in TP102 and WS106 including fine fragments of brick, tile and concrete. This was underlain by interbedded medium dense to dense occasionally loose sandy gravels, silty sands and firm occasionally stiff gravelly clays representing the Kempton Park Gravels Member which were underlain in 9 No. of the 21 No. trial holes completed by highly weathered Chalk. In three locations the chalk was overlain by a layer of gravelly silt chalk head deposits representing the entirely weathered former upper surface of the Chalk.

The Kempton Park soils were highly variable and showed little consistent variation across other than a slight increase in the proportion of sand towards the north of the site and a reduction in clay content with depth. The thickness of the superficial deposits showed a general deepening towards the northeast of the site. Occasionally pockets of off white gravelly silt were encountered within the superficial deposits which were considered to represent weathered chalk fragments within the superficial soils.

The depth to chalk was highly variable ranging from 1.2m to >4.0m bgl across the site and showed a general deepening towards the northeast. The upper surface of the chalk encountered within the trial pits was noted to be irregular and vary in depth significantly from one end of the pit to the other. The chalk encountered was highly weathered. WS104 situated in the central east of the site encountered a layer of chalk from 1.7m to 2.0m bgl which was underlain by loose sand to 2.9m below which chalk head was encountered. This chalk band may represent a chalk fragment deposited within the superficial soils, alternatively this may be indicative of an infilled dissolution feature within chalk in this area.

15.2 Public Open Space Area

Table 8: Summary of soils encountered across the POS area (TP04, TP05, TP115 & TP116).

Depth From (m)	Depth To (m)	Soil Type	Description
0.0	0.25 / 0.30	**TOPSOIL**	Dark brown sandy gravelly silty TOPSOIL with abundant rootlets. Gravel is fine to coarse flint.
0.25 / 0.30	2.0 / 2.8*	**CLAY and SAND (Alluvium).**	Interbedded: Loose to medium dense orange brown very clayey silty fine to medium SAND with occasional medium rounded flint gravel and pockets of off white silt gravelly chalk head. AND Soft to firm orangish brown silty very sandy gravelly CLAY. Gravel is fine to coarse occasionally cobble sized rounded flint.
2.0 / 2.8	2.40* / 3.20*	**CHALK**	Off white completed weathered structureless variably grade Dm and Dc CHALK with occasional subrounded to rounded flint cobbles. Not encountered in (TP116)

*full depth of investigation

The public open space portion of the site was underlain by topsoil over interbedded soft to firm sandy gravelly clays and loose to medium dense clayey sands to between 2.0 and 2.8m bgl over highly weathered chalk to the full depth of investigation. The chalk was not encountered in TP116 which was terminated at 2.4m bgl due to pit sides being unstable.

15.3 Infilled Pits

Table 9: Summary of soils encountered across the POS area (TP106 and TP111).

Depth From (m)	Depth To (m)	Soil Type	Description
0.0	0.20 / 0.30	**Reworked TOPSOIL**	Brown gravelly sandy silty reworked TOPSOIL. Gravel is fine to coarse flint, brick, plastic, blacktop and concrete.
0.20 / 0.30	1.50 / 2.0	**MADE GROUND**	MADE GROUND comprising brown to orange brown mottled off white and brick red slightly clayey gravelly sand and sandy gravel. Gravel comprised chalk and flint in TP106 and brick, plastic, wood, metal and electronics in TP111.
2.0	2.3	**MADE GROUND**	Dark brown mottled black green and white gravelly sandy clay MADE GROUND. Gravel is fine to coarse subrounded to rounded flint, fine chalk, metal, wood metal wire, and cannisters, tar and rubber. (TP106 only)
1.5	2.3	**GRAVEL**	Orange to orange brown slightly clayey sandy GRAVEL or fine to coarse occasionally cobble sized sub-angular to rounded flint (TP111 only)
2.3	3.15	**CLAY**	Firm brown mottled dark brown silty sandy CLAY. (TP106 Only)

*full depth of investigation

The two infilled pits were topped with a layer of reworked topsoil overlying made ground (infill). Within TP106 the made ground generally comprised silty gravelly sand to 2.0m bgl with fragments of chalk and flint below which was a dark brown mottled green layer of made ground including fragments of metal, wite, plastic, tar, glass and metal cannisters. The made ground extended to 2.3m in TP106, below which firm natural clays were encountered.

TP111 comprised made ground underlying the topsoil to 1.5m bgl. The made ground was sand gravelly clays with household and general waste including, bric, metal, plastic, fabric and electronic household appliances. This was underlain by clayey sandy flint gravel to depth.

15.3.1 Groundwater

Groundwater strikes were recorded in the following trial holes:-

Table 10: Groundwater Strikes

Trial Hole	Date of water strike	Depth to Groundwater strike (mbGL)	Depth to Groundwater strike (m AOD)	Comments
TP101	12/04/23	2.3	35.95	Soil recovered damp at 2.3m bgl.
TP110	11/04/23	2.9	33.87	Groundwater seepage at 2.9m bgl
TP111	11/04/23	1.8	34.81	Soil recovered damp to the touch at 1.8m bgl.

TP112	11/04/23	1.6	33.89	Groundwater seepage at 1.6m bgl.
TP114	11/04/23	1.0	36.58	Groundwater seepage at 1.0m bgl.
TP115	11/04/23	2.8	33.07	Groundwater seepage at 2.8m bgl.
TP116	11/04/23	1.0	33.79	Groundwater seepage at 1.0m bgl.
WS105	12/04/23	3.0	32.92	Groundwater seepage at 3.0m bgl.

Groundwater monitoring results are summarised as follows:-

Table 11: Groundwater Monitoring Results

Monitoring well	Depth to groundwater (mbgl) [m AOD]		
	18/04/23	24/04/23	04/05/23
WS101	Dry [<34.74]	Dry [<34.74]	Dry [<34.74]
WS103	Dry [<35.02]	Dry [<35.02]	Dry [<35.02]
WS105	1.78 [34.14]	1.86 [34.06]	1.94 [33.98]
WS106	1.28 [34.11]	1.41 [33.98]	1.49 [33.90]

The full monitoring results are provided in Appendix H. It should be noted that groundwater monitoring was undertaken in the spring months following an unusually dry February and as such shallower groundwater levels should be anticipated during the winter months.

15.3.2 Visual and Olfactory Evidence of Contamination

Visual and olfactory evidence of contamination noted during the investigation works is summarised in the following table.

Table 12: Visual and Olfactory Evidence of Contamination

Location	Depth (m bgl)	Olfactory Evidence	Visual Evidence
TP102	0.60	-	Reworked slightly gravelly sandy clayey subsoils encountered with concrete and brick.
TP106	2.0 – 2.3	-	Made ground encountered including fragments of wood, metal, rubble and tar.
TP111	0.0 – 1.5	-	Made ground encountered

Location	Depth (m bgl)	Olfactory Evidence	Visual Evidence
			including metal, plastic, wood, fabric and brick.

Deep made ground was encountered in trial pits TP106 and TP111 situated within the areas of the former gravel pits. The made ground included fragments of wood, metal, brick and in the case of TP111 large metal objects.

E GEOTECHNICAL INFORMATION

16 Strata Encountered

16.1 Made Ground

The site is generally underlain by topsoil, however made ground to depths of between 1.5m and 2.3m, was encountered in in TP106 and TP111 in the area of the former gravel pits.

Made ground or fill is by nature highly variable in both composition and bearing capacity, and can be subject to large differential settlements when loaded. It is therefore generally unsuitable for use as a bearing stratum. In addition, made ground may contain contaminated and/or putrescible material. It can therefore be potential source of contamination and landfill gas.

16.2 Alluvium

In the public open space area of the site the topsoil was underlain by interbedded clayey sand and sandy clay alluvium deposits.

16.2.1 Clay and Sand

The results of limited geotechnical testing undertaken on the alluvial soils are summarised in 13 below.

Table 13: Summary of Geotechnical Test Results for Clay

Test	Range
Perth penetrometer blow counts	(5 – 16)
Undrained shear strength (kN/m^2)	16 - 69

Parentheses indicates testing completed during previous investigation.

Limited insitu testing has been undertaken in the POS area. Shear vane tests undertaken in the cohesive soils ranged from 16kPa to 69kPa indicating very soft to firm deposits. Perth penetrometer tests undertaken during the previous soakage testing return blow counts of 5 to 16 within the sands and 15 within the clays indicating loose to medium dense and firm deposits respectively.

16.3 Kempton Park Gravels

Across the developable area of the site the topsoil and where present made ground were underlain by interbedded sandy clays, fine sands and sandy gravels of the Kempton Park Gravel.

16.3.1 Clay

The results of the geotechnical testing undertaken on the clays are summarised in 14 below.

Table 14: Summary of Geotechnical Test Results for Clay

Test	Range
SPT 'N value'	8 -14
SPT 'N_{60} value'	10 - 18
Perth penetrometer blow counts	(16)
Moisture Content (%)	13.1 – 14.9
Liquid Limit (%)	24 – 31
Plastic Limit (%)	13 – 14
Plasticity Index (%)	11 - 17
Undrained shear strength (kN/m^2)	88
Water Soluble Sulphate Content (g/l)	<0.010
Acid Soluble Sulphate	0.013 - 0.030
Total Sulphur (%)	0.010 – 0.020
pH	7.6 – 8.5

The results of limited Atterberg limit testing undertaken on the cohesive soils indicate they comprise low plasticity clay. An A line plot of the plasticity testing results is presented in Figure 4 Appendix B.

Due to the high sandy and gravel content of the clays it was generally not possible to undertake insitu shear vane testing. The results of one shear vane test completed returned an undrained shear strength of 88kPa indicative of firm to stiff clays. This is in general accordance with field observations and the results of Standard Penetration testing. SPT N_{60} values of N=10 to N=18 indicative of firm to stiff clays were encountered within the windowless sampler boreholes.

16.3.2 Sands & Gravels

The results of the geotechnical testing undertaken on the granular soils are summarised in Table 15 and Table 16 below.

Table 15: Summary of Particle Size Distribution tests for Sand/Gravel

Location	Depth (m)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobbles (%)
TP101	1.10	16.4		39.8	43.8	0.0
TP102	1.20	11.3	12.6	75.6	0.5	0.0
TP109	1.10	8.0		26.3	60.5	5.2
TP113	1.50	10.9	16.5	27.6	45	0.0

The results of particle size distribution (PSD) testing indicate that the soils comprise slightly clayey slightly silty sandy gravels and gravelly sands with occasional cobbles. The co-efficient of uniformity and curvature indicate that the sands and gravels vary from well graded to gap graded.

Table 16: Summary of Geotechnical Test Results for Sand and Gravel

Test	Range
SPT 'N value'	7 - 31
SPT 'N_{60} value'	9 - 40
Water Soluble Sulphate Content (g/l)	<0.010
pH	7.8 - 7.9

Standard penetration tests undertaken in the granular soils return N_{60} values of N=9 to N=40 indicating loose to very dense sands and gravels. N values indicative of loose soils were only encountered in WS101 and WS104 at 1.0m bgl and 2.0m bgl respectively.

16.4 Chalk – White Chalk Subgroup

The interbedded soils of the Kempton Park Gravels were underlain by Chalk of the White Chalk Subgroup. The results of the geotechnical laboratory testing completed on the chalk are summarised in Table 17 below.

Table 17: Summary of Geotechnical Test Results for Chalk

Test	Range
SPT 'N' value	2 - 33
SPT 'N_{60}' value	3 - 42
Dry Density (Mg/m^3)	1.47 – 1.57
Saturated Moisture Content (%)	27 - 31

The chalk has been characterised in accordance with CIRIA C574[15] from a visual assessment of the chalk excavated from the trial pits and the saturated moisture contents. Classification of the chalk encountered in the windowless sampler boreholes was not possible due to disturbed nature of the samples recovered. The chalk returned intact dry densities of 1.47 to 1.57Mg/m^3 indicating the chalk encountered is low to medium density. In addition two further samples of the chalk taken from WS101 and WS105 was schedule for testing but the chalk

[15] CIRIA C574 Engineering in Chalk (2002)

was so highly weathered the samples recovered were not suitable for testing. On this basis the chalk is classified as low occasionally medium density Grade Dm occasional Dc chalk.

Standard Penetration Tests undertaken in the chalk returned SPT N_{60} values of N=3 to N=42. Low N values of <10 were recorded in seven of the 13 No. tests undertaken within the chalk. The low blow counts recorded are indicative of structureless chalk while the high values often coincide with where flint gravel is logged within the chalk. Furthermore, it is noted that N values generally decreased with depth with N values of less than 10 recorded below 3.0m in all boreholes where chalk was encountered. It is considered that these lower blow counts likely relate to softening of the chalk around the water table due to seasonable variations in groundwater level on site. A plot of the SPT result vs depth is presented in Figure 5.

The ground conditions encountered in WS104 where chalk was encountered overlying loose sands which were themselves underlain by chalk may indicate that a potential solution feature is present in this area of the site and that there is the potential for other such features to be present elsewhere on site.

F GEOTECHNICAL APPRAISAL

17 Geotechnical Design

The foregoing geotechnical appraisal does not constitute a Geotechnical Design Report in accordance with BSEN1997. The following recommendations are for preliminary design purposes only.

For the detailed design, the short-term and long-term design situations must be considered. Where relevant, the following limit states should be considered:-

- Loss of equilibrium of the structure or the ground, considered as a rigid body, in which the strengths of structural material and the ground are significant in providing resistance (EQU)
- Internal failure or excessive deformation of the structure or structural elements in which the strength of structural materials is significant in providing resistance (STR)
- Failure or excessive deformation of the ground, in which the strength of soil or rock is significant in providing resistance (GEO)
- Loss of equilibrium of the structure or the ground due to uplift by water pressure or other vertical actions (UPL)
- Hydraulic heave, internal erosion and piping in the ground caused by hydraulic gradients (HYD)

The following factors should also be considered.

- Overall stability and ground movements
- Nature and size of the proposed construction including the design life
- Conditions with regards to the surroundings (e.g. neighbouring structures, traffic, utilities, vegetation, contamination etc.)
- Ground and groundwater conditions
- Influence of the environment.

18 Geotechnical Appraisal

18.1 Swelling and Shrinkage

Much of the development area of the site is underlain by granular soils with only localised clay encountered as well as shallow sand clay subsoil in some areas of the site. Based on the laboratory test results in Section E, an preliminary classification of NHBC **LOW** Volume Change Potential (VCP) is recommended for the clay soils.

Foundations will therefore require deepening in accordance with NHBC Chapter 4.2 where clay soils are encountered near trees. Foundation depths should be calculated based on the mature height of the tree, however, the existing height is relevant for trees which are to be removed. Deepening may be terminated where the medium dense gravels/sands or chalk are encountered at depth.

The BGS GeoClimate study (UKCP18)[16] indicates the potential change in subsidence due to changes in climate. The results project a 6.5% of properties will be affected by swelling and shrinkage by 2030, rising to 11% by 2070 (compared to 3% in 2020).

18.2 Sulphates

Construction activities that may substantially disturb previously unweathered strata and expose sulfur minerals such as pyrite to air, water and bacteria can result in the relatively rapid oxidation of such minerals producing high levels of sulphates. In accordance with the BRE[17] methodology, 3 No. samples of the superficial clay soils were therefore tested for water and acid soluble sulphate, total potential sulphate (TPS) and pH. Two further samples, one each of the sand and the gravel were tested for water soluble sulphate and pH.

Based on the results of the testing, oxidisable sulphides (OS) are generally <0.3%, indicating significant volumes of pyrite are not present. The soils are therefore classified as Design Sulphate Class DS-1 and assuming mobile groundwater, the ACEC class is AC-1.

18.3 Groundwater

Groundwater seepages were encountered in 8 No. investigation locations as part of this phase of investigation and 3 No. further locations as part of the previous soakage testing works. Seepages were encountered between 1.0m bgl and 3.0m bgl although it is noted that seepages shallower than 1.5m bgl were encountered in the public open space area (adjacent to the river) only. Seepages were encountered in the southeast, southwest and northwest of the but were absent in the north and northeast of the site.

Subsequent groundwater level monitoring (results are given in Section D15.3.1) undertaken between April and May 2023 recorded groundwater levels between 1.28m and 1.94m bgl with groundwater levels showing a gradual decline through the monitoring period. Groundwater

[16] https://www.bgs.ac.uk/news/maps-show-the-real-threat-of-climate-related-subsidence-to-british-homes-and-properties/

[17] Building Research Establishment Special Digest 1: 2005. Concrete in aggressive ground. Part 1: Assessing the aggressive chemical environment.

was recorded within WS105 and WS106 only throughout the monitoring period with the wells installed in WS101 an WS103 remaining dry to 3.0m bgl throughout.

On the basis of these results, groundwater at about 1.0m to 1.5m below ground level should be anticipated in the lower lying areas of the site particularly during the winter months. During the winter months it is probable that groundwater levels in the areas of the site where groundwater has, so far, not been encountered will be shallower and further monitoring of the groundwater levels during the winter months may be required to aid the final design and fully assess the groundwater regime.

Winter groundwater levels are anticipated to rise in some areas of southern England. Storage on site will be reduced and may make conventional soakaways inappropriate for this development.

18.4 Soakage Potential

Five BRE 365 soakage tests were undertaken on site by Leap in March 2021. The results of the testing are fully discussed in Leap report ref. LP2497/ST/1 which the reader is referred to and is also summarised in Section 9 above.

No further infiltration testing was undertaken as part of this investigation. However, dry density and saturation moisture content testing of the chalk was undertaken which indicates the chalk on site is of low density. CIRIA C574 outlines that where low-density chalk is present soakaway should be situated **at least** 10m from the nearest foundation. It goes on to outline that where solution features are known to be present soakaways should be situated at least 20m from the nearest foundation. At this stage no significant evidence for potential solution features has been identified on site. However, the upper surface of the chalk has been noted to be highly irregular and a band of sand which appeared to be within the chalk was encountered in WS104. As such it is recommended that should soakaways or the SUDs features be proposed further investigation in these areas is undertaken to confirm that no loose / soft soils indicative of a solution feature is present in the vicinity.

The site is situated within a groundwater Source Protection Zone 2. Generally, an unsaturated zone is required beneath the discharge zone and the groundwater. Discharges of surface water to ground may be permitted by the Environment Agency, where an unsaturated zone is present (allowing for seasonal variability) and will need to form part of an appropriately designed drainage scheme in accordance with The SUDS Manual CIRIA C753[18].

Direct discharge of clean, uncontaminated roof water to groundwater may be permitted, provided that the discharge is via separate, sealed downpipes.

[18] CIRIA C753 The SuDS Manual (2015)

18.4.1 Sustainable Considerations for soakage design

Shallow groundwater seepages have been encountered during these works with resting groundwater levels between 1.28m and 1.94m bgl recorded in some areas of the site. As such storage capacity of any proposed soakaways is likely to be limited. Furthermore, winter groundwater levels are anticipated to rise in some areas of southern England. Storage on site will be reduced and may make conventional soakaways inappropriate for this development.

Design of a SUDS scheme which can incorporate biodiversity net gain into the development and will support the NPPF requirement for multifunctionality managing water quality and design while improving diversity.

18.5 Bearing Capacity and Foundations

18.5.1 Shallow Foundations

Allowable Bearing Capacity or Pressure is a conservative estimate of the ultimate bearing resistance of the ground, selected on the basis of the soil/rock description, and taking a presumed degree of settlement into account. It has traditionally been used to check simple foundation designs. The use of this method is acceptable under BS EN 1997-1[19] as a "prescriptive method", with the allowable bearing pressures now termed "presumed bearing resistance".

The presumed bearing resistance is highly dependent on proposed depth of foundation, width of foundation and the structure's tolerance for settlement. The following section provides a preliminary presumed bearing resistance assuming a stated depth and width of foundation and assumes that settlements of up to 25mm can be tolerated by the structure. Should alternative foundation depths and dimensions be required, or the proposed structure have different long term movement requirements then the following assessment should be re-evaluated.

All loads should be transferred beneath any topsoil, made ground, loose, soft, low strength, desiccated or disturbed soils and transferred onto the firm clays and medium dense sands and gravels below about 1.0m depth. On the basis of the findings of the intrusive investigation to date including the presence of localised loose/soft soils, a preliminary presumed bearing resistance of 90kPa may be assumed for a 600mm wide foundation on the firm clays and medium dense gravels below about 1.0m. In the south of the site where the chalk was encountered between 1-2m bgl, a preliminary bearing resistance of 90kPa may also be assumed, it is recommended that any footings are keyed into the bearing stratum. However, foundations will require deepening in the clay soils near trees to NHBC LOW VCP precautions.

The site has been assessed as having a moderate risk of solution features. Loose sands have been encouneterd on site, and very low SPT N blow counts have also been returned in the

[19] BS EN 1997-1(2004)+A1:2013 Eurocode 7:Geotechnical Design: General Rules

chalk. Further investigation would be required to assess the presence of solution features on site. At this stage, foundations should be reinforced and designed to span 5m.

The made ground encountered in the former gravel pits was highlight variable and included fragments of compressible material including, electronics, rubber and wood. Care must be taken to ensure any foundations extend through this anthropogenic material into the underlying natural soils.

Further investigation may enable an increase in the allowable bearing resistance and may be required to meet the requirements of BS EN 1997 and BS 8004[20]. At this stage it is understood that no development is proposed in the area of the site, underlain by alluvium. Should the proposed layout change, or should soft alluvial soils be encountered during the construction phase further assessment of the suitable foundation solution would be required.

Where foundations are stepped or span different soil types, allowance should be made for nominal reinforcement.

18.5.2 Piling

The site is underlain by natural granular soils with relatively shallow groundwater levels recorded on site. During the investigation works excavations were noted to be unstable even in the short term within the trial holes excavated. Furthermore, localised deep made ground is present on site associated with the infilled pits.

Based on the above it may be preferable to pile at least some of the proposed plots on site. Investigation for pile design was beyond the scope of these works and would require deep boreholes to extend at least 5m below the base of the deepest proposed pile.

18.5.3 Sustainability Considerations for Foundations

At this stage recommendations have been provided for conventional strip footings only. However, given the potential for trench instability as well as areas of localised deep made ground, piled foundations may be a preferable less carbon intensive option across some or all of the site. To enable a preliminary comparison of the relative embodied carbon of the foundation's options a 15m long 400mm diameter cfa pile has been assumed.

LEAP's foundation carbon calculator has then been used to consider the intrinsic carbon dioxide generated from the materials which make up the foundation as well as emissions associated with onsite plant, earthworks and the disposal of trench/pile arisings.

Based on the limited information available to date on the proposed construction, the carbon calculator indicates that assuming the foundations summarised above and that nominal reinforcement is utilised within the conventional foundations on site then traditional footings would be the less carbon intensive option.

[20] BS 8004:2015+A1:2020 Code of Practice for foundations

The model also indicates that for the majority of the site where traditional foundations are to be extended below 1.9m bgl then piled foundations are the less carbon intensive foundation option. This depth reduces slightly to 1.8m in the areas of the site where deep made ground is present.

Further more detailed calculations and wider sustainability assessments can be provided and you can register your interest in such an assessment via the sustainability section of our website here.

18.6 Floor Slabs

With reference to NHBC Standard 5.2, suspended floor slabs are recommended:-

- Where the depth of fill exceeds 600mm
- Where foundations are deepened below 1.5m in accordance with NHBC Standards Chapter 4.2
- Where desiccated soils are encountered
- Where vibratory ground improvement techniques have been used
- On sloping sites
- Where the is a risk of solution features
- Where foundations have been piled.

Suspended floor slabs are therefore recommended on site.

The site has been assessed as at risk from Radon gas. Special precautions are therefore required to be incorporated into the floor slab design, as detailed in Section G23.

18.7 Roads

CBR testing was beyond the scope of works. However, as a preliminary guide LR1132[21] indicates that for clays with a plasticity index ranging from 10 – 20% assuming average construction conditions and a high water table an estimated CBR value 3 to 4% should be anticipated. It goes on to outline that for well graded sands and sandy gravels CBR values of 40% and 60% respectively are to be anticipated.

The shallow soils are assessed as marginally frost susceptible, based on the results of the plasticity testing (see Section E). Given the high silt content of the silty sands, allowance should also be made for a frost susceptible subgrade.

18.7.1 Recommendations

[21] TRRL Laboratory Report 1132 The structural design of bitumous roads. Powell, Potter Mayhew and Nunn (1984)

A design CBR value of 3% is recommended for a sand clay subgrade. Where formation level is within the granular soils a CBR values of 40% may be appropriate. Confirmatory testing will be required if the proposed roads are to be adopted.

It is assumed that formation level of the proposed roads will be above chalk rock head across the site. However, CIRIA C574 "Engineering in Chalk" states that a design CBR value of 2% is appropriate for highly weathered in-situ chalk.

Deep made ground is present in the area of the two former gravel pits and made ground should also be anticipated beneath the farmyard area. Where made ground is encountered at formation level, over excavation to, say 1m below ground level, proof rolling and then controlled back filling to formation level with a suitable granular fill is recommended.

18.8 Excavations

During the investigation works the sides of 7 No. of the 15 No. trial pits undertaken across the site were noted to be unstable during excavation. Excavations in made ground and granular superficial soils are likely to be unstable and subject to collapse even in the short term. Any excavation below the water table will be unstable and running sands should also be anticipated. Excavations extending below the water table will require dewatering.

Close lateral support will be required in all excavations where man entry is required.

18.9 Filling

The preliminary recommendations contained within this report assume that ground levels are to remain at a similar level across the site for the proposed development, and that no significant changes in level are proposed. In the event that ground levels are to be raised, this may induce significant settlement, particularly across the areas of alluvium and the infilled gravel pits, which could adversely effect foundation design, drainage etc. Where significant changes in ground levels are proposed then further investigation will be required to assess the impact of such earthworks on the above recommendations.

18.10 Slope Stability

The site and local topography are relatively level. Provided no significant level changes are proposed, no slope stability issues are anticipated. However, if significant levels changes are proposed, then global stability checks are recommended.

18.11 Retaining Walls

Leap have not been made aware that any retaining walls are proposed on site.

18.12 Settlement

Based on the presumed bearing resistance given in Section 18.5, settlements should be within typical tolerable limits for the low rise development proposed.

If soft clays are encountered at formation level or below, significant settlement should be anticipated and serviceable limit state analyses will be required.

At this stage it is assumed that ground levels will remain at the current level for the proposed development. If significant level raises are proposed, this may induce significant settlement in the natural alluvial soils along with the made ground within the gravel pits and detailed settlement analyses will be required.

Where foundations are stepped or span different soil types, differential settlement should be anticipated and allowance should be made for nominal reinforcement.

18.13 Heave and Uplift

In accordance with NHBC Standards Chapter 4.2, precautions against heave should be used where foundations are within the influence of trees and the resulting foundation depth is greater than 1.5m. Compressible material must be provided against the inside faces of all external wall foundations greater than 1.5m in depth. For pier and beam foundations, additional voids are required below ring beams.

For piled foundations, the effect of uplift induced by heave must be included in the pile design. Piles should be reinforced for the length of pile governed by the heave design, and allowance should be made for the inclusion of void former or similar on the underside of ground beams.

18.14 Solution Features

The site is situated within an area of potential risk of solution features. At this stage no significant evidence for potential solution features has been encountered on site. However, it is noted that some evidence for a potential feature was noted in WS104 and that the upper surface of the chalk was found to be very irregular across the site.

At this stage additional investigation is recommended to assess the density of the superficial deposits and the chalk at depth, noting the very low blow counts recorded in the chalk in the windowless sampled trial holes. At this stage, shallow foundations may be applicable, but allowance should be made for reinforced footings designed to span 5m.

Additional investigation in the vicinity of any proposed soakaways is also recommended to confirm that no loose / soft soils are present. Should evidence for potential solution features be encountered as part of any further investigation works then additional investigation and assessment of the risk would be required.

19 Geotechnical Recommendations

Further assessment including a geotechnical design report will be required once the details of the proposed construction are known.

Further assessment of the density of the superficial soils and the chalk at depth using dynamic probing or CPT techniques is recommended. Some piled foundations are indicated in the location of the gravel pits and may also be required in the south of the site where groundwater is shallow and running sands are anticipated. If piled foundations are proposed further investigation comprising deep boreholes extending at least 5.0m below the base of the proposed pile will be required to enable pile design to be undertaken.

If soakaways are proposed as part of the development investigation in their vicinity is recommended to confirm that intact chalk is present at depth and that no evidence for soft / loose soils is encountered in the vicinity.

As outlined in section 19.5 above a preliminary carbon calculation indicates that where traditional foundations are to be extended below 1.9m bgl then piled foundations are the less carbon intensive foundation option assuming a 15m long 400mm diameter cfa pile. .

Further calculations and wider sustainability assessments can be provided if required.

Discussions on site with the current landowner indicate that a bomb may have previously fallen on site. It is recommended that a detailed UXO risk assessment of the site is undertaken prior to any further intrusive works being completed on site.

G GEO-ENVIRONMENTAL QUANTITATIVE RISK ASSESSMENT

20 Revised Conceptual Site Model

20.1 Introduction

The preliminary conceptual site model in Section C identified a number of plausible contaminant linkages. The revised CSM provides an updated understanding of the site based on the findings of the site investigation and analytical results and was used to inform the quantitative risk assessment (QRA) undertaken in Sections 21 to 23 in the context of the proposed residential land use.

Following completion of the site investigation no significant revisions to the CSM are considered necessary before carrying out the generic quantitative risk assessment (GQRA). During the investigation no visual or olfactory evidence for petroleum hydrocarbon contamination was encountered. As such the risks associated with PHC contamination within the areas of the site investigated to date have been discounted. This assessment would revision if evidence for such contaminants are encountered during subsequent investigation works or during the construction phase.

20.2 Distribution of Made Ground

The exploratory logs are provided in Appendix F and a summary of the laboratory analytical results in Appendix J.

Made ground was encountered in TP106 in the north of the site to 2.3m bgl and in TP111 in the east of the site to 1.5m bgl. In both cases the made ground included fragments of anthropogenic material including metal, brick, concrete and tile. In the case of TP106 the made ground was noted to also contain metal cannisters and fragments of a solid tar like material. The made ground in TP111 including fragments of hessian like fabric and electronic items including a record player and a washing machine.

Reworked topsoil was noted containing anthropogenic fragments of brick and concrete in TP102 and WS106. TP102 is situated close to a field entrance, and it is considered this material was likely placed or tracked into the field. WS106 is situated just to the west of the farmyard area.

20.3 Human Health

Given the nature of the contaminants encountered, plausible contaminant linkages for exposure to future residents and groundworkers at the site are confirmed as follows:

- Ingestion of contaminated soils.

- Inhalation of contaminated soil particles/dust and asbestos fibres.
- Dermal contact with contaminated soils.
- Ingestion of homegrown produce (future residents only).

20.4 Ground Gases

Deep made ground was encountered in two trial holes (TP106 and TP111) in the area of the two former gravel pits. The made ground extended to 2.3m and 1.5m bgl respectively and generally comprised gravelly sand and clayey gravel. Occasional fragments of degradable material including wood and fabric were noted but were not abundant. Total organic carbon testing of the made ground soils ranged from 1.21% to 2.21% Based on the localised nature of the made ground and the relatively low TOC concentrations recorded the made ground within the infilled pits on site is not considered to pose a significant gas generation source.

21 Human Health Risk Assessment

21.1 Rationale and Approach

The generic quantitative risk assessment (GQRA) for human health was conducted in line with the CLEA methodology by comparing the soil analytical results from the ground investigation with Generic Assessment Criteria (GAC). The GACs were selected using the rationale and assumptions provided in Appendix L.

Sets of soil GACs are available for SOMs of 1%, 2.5% and 6%. In this case, TOC in the samples that were analysed ranged from 0.28 to 2.21%. Using the conversion of SOM = TOC x 1.72, this equates to a SOM range of 0.48 to 3.8%. 1% SOM was considered to be appropriate to maintain conservatism.

For some contaminants of concern, direct contact will be the dominant pathway for exposure. In order to support with development options, human exposure to all unsaturated soils, irrespective of depth, has been considered for the purpose of this assessment. This will maximise the information available to the design team on the suitability of all unsaturated material and can support with their materials management options.

The risk assessment did not include statistical analysis. CL:AIRE 2020[22] provides guidance on the appropriate sample sizes for particular statistical distributions of data and non-targeted soil sampling approaches. The number of soil samples collected in the site investigation indicates that statistics are not appropriate to use in this case.

[22] CL;AIRE, 2020 'Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.' CL:AIRE, Buckinghamshire. ISBN 978-1-905046-35-5.

The focus of the GQRA was chronic risks to human health because these often occur at lower doses than acute responses to exposure. Groundworkers during construction and future maintenance may be exposed to unacceptable levels of contamination. The CLEA assessment approach is designed to evaluate long term chronic exposure to contaminants and therefore, this approach is not appropriate for groundworkers who will be exposed for short durations on a site. As such, a GQRA was not undertaken to evaluate the potential for unacceptable exposure to groundworkers and future maintenance workers. A qualitative evaluation is however, provided in Section 21.2.

Future residents were determined in the revised CSM to be at low risk from ground gases (carbon dioxide and methane) derived from the infilled gravel pits. The quantitative assessment of these risks is provided as part of the wider evaluation of ground gases in Section 23.2.

21.2 Evaluation of Potential Risks to Future Residents

The soils that were analysed comprised eight samples of topsoil, two samples of the subsoil and three samples of the made ground. The laboratory analytical results were assessed to determine the potential risks to future site users under a generic residential land use scenario assuming that homegrown produce are consumed (resi HGP). The quantitative risk assessment is provided in Appendix H and the laboratory certificates are provided in Appendix I. A summary table is provided in Table 18 below. Only detected pesticides have been included within the table.

Table 18: Summary of Soil Contamination Test Results

Determinand	Number of samples	Number >LOD	Maximum Conc. (mg/kg unless otherwise stated)	Generic Assessment Criteria (mg/kg)	Number of Exceedances
METALS					
Arsenic	12	11	12	37	0
Cadmium	12	1	1.1	22	0
Chromium	12	12	18	910	0
Hexavalent Chromium	12	0	<1	21	0
Copper	12	12	244	2,400	0
Lead	12	12	305	200	1 (TP106 at 2.1m)
Mercury[1]	12	3	4.53	40	0
Nickel	12	12	23	130	0
Selenium	12	1	2	250	0
Zinc	12	12	6790	3,700	1 (TP106 at 2.1m)
ASBESTOS					
Asbestos	12	0	None detected.	Presence	0
HYDROCARBONS					
Benzo(a)pyrene[2]	12	2	0.45	5.0	0
Naphthalene	12	2	0.25	5.6	0
Total PAHs	12	2	157	n.v.	-

Notes to table

1. *Assessment criterion based on inorganic mercury*
2. *As a surrogate marker for genotoxic PAH*
3. *As a marker compound for threshold PAH*

n.v. – no appropriate value

The results of chemical testing of the shallow soils on site generally returned low contaminants concentrations below the GAC values for a residential development with private gardens. Elevated concentrations of lead and zinc were recorded in the made ground in TP106. The concentrations recorded exceed the GAC values and as such would pose an unacceptable risk should they be retained in private gardens It is noted that the elevated concentrations

recorded were at a significant depth (2.1m bgl) and as such it is unlikely that future residents would come into contact with such contaminants. However, testing of the shallower overlying made ground at this location was not undertaken.

No asbestos was detected within any of the samples tested. None of the pesticides tested for were recorded above the laboratory limit of detection.

21.3 Evaluation of Potential Risks to Groundworkers

There is a legal duty for employers to ensure that suitable health and safety controls should be in place to protect groundworkers and they should evaluate the potential for exposure including using data provided in this report which should be included in any future Health and Safety file for the site under The Construction (Design and Management) Regulations 2015.

Groundworkers will be exposed to any and all contaminants present within the ground albeit for a relatively short period of time. Given the generally low contaminant concentrations recorded it is considered that assuming appropriate PPE is in use and site hygiene is well maintain the risk to groundworkers is low.

22 Controlled Waters Risk Assessment

The site is underlain by the Kempton Park Gravel Secondary A aquifer and the Chalk Principal aquifer and is situated within zone 2 of a groundwater Source Protection Zone. During investigation on site groundwater seepages were encountered between 1.0m and 3.0m bgl although was generally encountered below 1.5m bgl in the developable portion of the site. Subsequent groundwater monitoring encountered resting groundwater levels between 1.28m and 1.94m bgl in the south and southwest of the site. The monitoring wells installed in the north of the site were dry to their full depth of 3.0m bgl. Groundwater levels should be anticipated to be closer to ground level during the winter months. Chemical testing of the shallow soils generally returned very low contaminant concentrations with the exception of a sample of the made ground in TP106 (within the former gravel pit) at 2.1m bgl which exhibited elevated concentrations of metals lead and zinc. Given the depth of the made ground it is probable that these contaminated soils are in direct contact with the groundwater at least during the winter.

However, given the localised nature of the impacted soils any contamination from the made ground leaching into the groundwater is likely to diffuse to very low levels. Based on the above it is considered that the contamination is unlikely to pose a significant risk to the underlying aquifer.

23 Ground Gas Risk Assessment

23.1 Rationale and Approach

Two preliminary rounds of ground gas monitoring have been undertaken on site within the groundwater monitoring wells. These wells were all located outside of the extent of the infilled pits and as such only provide information on whether gases generated within the infilled ground is migrating laterally through the natural granular soils.

An initial assessment of the results has been undertaken based on the method outlined in BS8485:2015+A1:2019. The gas concentrations and borehole flow rates recorded are combined to provide a hazardous gas flow rate (Q_{hg})for carbon dioxide and methane for each well during each monitoring visit. The method is outlined below:

$$Q_{hg} = \text{Maximum gas concentrations x steady state flow rate.}$$

The guidance outlined that gas situation value (GSV) is assigned for the site based on the highest derived Q_{hg}. Where no flow or gas concentrations were recorded 0.1 l/hr and 0.1% (the limits of detection for the equipment used) were used in the calculation of Q_{hg}.

An additional review of the gassing potential of the made ground on site has been made based in the made ground thickness and the total organic carbon content based on "the pragmatic approach to ground gas risk assessment" as presented by Card et al 2012[23] within Research Bulletin 17 (RB17). This approach considers the Total Organic Content (TOC) of the made ground as well as the age and depth of the fill.

23.2 Evaluation of Potential Risks from Ground Gas

The gas monitoring results are summarised in Table 19 below:

Table 19: Summary of land gas monitoring results

BH Ref	Date	Maximum Recorded Concentration*							Q_{hg} (CO_2) [CH_4]
		CO_2 (%)	CH_4 (%)	CO (ppm)	O_2 (%)	Flow rate (l/hr)	Atmospheric Pressure (mB)	Response zone flooded	
WS101	18/04/23	4.7	0.0	0	14.2	0.0	1021	No	(0.00447)

[23] Card G., Wilson S, Mortimer S. 2012. A pragmatic approach to ground gas risk assessment. CL:AIRE Research Bulletin RB17.

									[0.0001]
WS101	04/05/23	3.1	0.1	0	17.4	0.0	1009	No.	(0.0031) [0.0001]
WS103	18/04/23	4.0	0.0	0	11.8	0.0	1021	No.	(0.004) [0.0001]
WS103	04/05/23	2.6	0.2	0	14.6	0.0	1010	No.	(0.0026) [0.0002]
WS105	18/04/23	4.1	0.0	0	10.5	0.0	1022	Partially	(0.0041) [0.0001]
WS105	04/05/23	4.6	0.2	0	1.2	0.0	1010	Partially	(0.0092) [0.0002]
WS106	18/04/23	0.6	0.0	0	20.6	0.0	1021	Yes	(0.0006) [0.0001]
WS106	04/05/23	2.0	0.1	17.3	0	0.0	1006	Partially	(0.002) [0.0001]

Notes to table

** With the exception of oxygen which is recorded as minimum*

To date just two gas monitoring visits have been undertaken to provide a preliminary assessment. The maximum carbon dioxide concentration of 4.7% was recorded in WS101 during the April 18th visit. Relatively consistent carbon dioxide concentrations ranging from 2.0% to 4.7% were recorded in the wells on site throughout the monitoring period. Maximum methane concentrations of 0.2% were recorded in WS103 and WS104 during the May 4th visit although it is noted that these were both recorded as negative values. No flow was recorded in any of the wells during the monitoring period. Both monitoring rounds were undertaken during periods of high atmospheric pressure, however it is noted that pressure was falling during the 4th of May visit. Pressure was broadly stable during the 18th of April visit.

It is also noted that the response zone of WS106 was flooded during the April 18th visit.

Adopting the methods described in section 23.1, the preliminary GSV values for carbon dioxide and methane are as follows:

Table 20: Calculated Gas Screening Values

	Carbon Dioxide L/hr	Methane L/hr
Gas Screening Value	0.0047	0.0002

Based on the guidance and classification system set out in BS8485:2015+A1:2019 a preliminary classification of Characteristic Situation (CS1) is indicated on site.

It is however, noted that monitoring was undertaken outside the extent of the infilled pits. As such the review of the information pertaining to the pits has been undertaken based on the pragmatic approach to gas risk assessment.

The made ground within the two infilled extended to 2.3m bgl in TP106 and 1.5m bgl in TP111. Total organic carbon (TOC) testing across the site as a whole returned generally low carbon contents of 0.28% to 2.21% The TOC recorded within the made ground samples specifically ranged from 1.21% and 2.21%. The pits are mapped on site from circa 1910 and are no longer mapped by 1972 indicating that the made ground has been in place for 50+ years.

Based on a maximum made ground depth of 2.3m which appears to have been in place for over 50 years and TOC contents ranging from 1.21 to 2.21% the made ground on site is not considered to pose a significant gas risk to the proposed development. It is considered that the carbon dioxide encountered during the monitoring is likely a product of the weathering of the underlying chalk bedrock.

23.3 Radon

The site mapped within an area where 5 to 10% of properties are above the radon action level. In England Radon protection is required where greater than 3% of properties are above the action level. Based on this radon protection measures are required on site.

However, it is noted that this freely available radon mapping is in low resolution 1km grid squares. It is recommended that a BGS Radon Report is sourced for the site as this provides high resolution 25m – 50m mapping which may enable a reduction in the in the radon protection required across the site.

24 Geo-Environmental Conclusions

24.1 Ground Conditions

The site investigation undertaken on site to date has generally encountered topsoil over interbedded sands, gravels and clays of the Kempton Park Gravel Member of the Chalk at depth. Two areas of deep made ground associated with infilled former gravel pits were encountered in trial pits, TP106 and TP111 which extended to 2.3m and 1.5m bgl respectively.

Groundwater seepages have been encountered between 1.0 and 3.0m bgl and resting groundwater levels have been observed in the south of the site between 1.28m and 1.94m bgl.

Based on the investigation undertaken and the samples that were analysed the made ground encountered in TP106 is impacted with lead and zinc at concentrations above the assessment

criteria for the proposed development. None of the other contaminants tested for were encountered within any of the other samples tested at concentrations considered to pose a risk although it is noted that the made ground in the area of both pits contained a significant proportion of anthropogenic material, particularly in TP111, including washing machine parts, wood and fabric. The highly variable nature of the made ground could present a potential gas risk if pockets previously undetected organic material are present, and may be subject to significant settlement. At this stage it should be assumed that the made ground would be unsuitable as a growing medium in gardens of areas of open green space.

The central farmyard area of the site was still in use at the time of the investigation and as such investigation in this area was not possible. As such there is the potential for as yet unidentified contamination to be present in this area and further investigation and sampling is recommended once this area has been vacated.

The lead and zinc contamination identified in the infilled pit poses a risk to human health, where present in critical areas such as gardens or areas of soft landscaping. Contamination may impact human health through the direct ingestion, inhalation, skin contact and/or plant uptake pathways that would be present in a residential setting. The contaminated ground is considered to pose an unacceptable risk if it is to be retained in the near surface of garden/outdoor soft covered areas where direct human contact is feasible.

Given the very localised nature of the contamination identified it is considered that any leaching of the contaminants into the underlying aquifer would be diluted to such an extent as to not pose a risk to either groundwater or surface water receptors. Furthermore, no evidence for free phase contaminants was identified during the investigation. This assessment would require revision if significant as yet unidentified contamination is encountered during the construction phase.

24.2 Ground Gases

Two rounds of preliminary ground gas monitoring were undertaken on the four wells install on site. Maximum carbon dioxide and methane concentrations of 4.7% and 0.2% were recorded respectively. No flow was recorded within any of the wells during either monitoring round.

Based on the above the preliminary assessment of ground gases detected in the recent monitoring programme determined that the site is likely to pose a very low risk to human health or structures with respect to methane and carbon dioxide. In accordance with BS8485:2019, the site was classified Characteristic Situation (CS) 1 based on the available data.

This is supported by the review of the site data using the Pragmatic approach based on maximum made ground thicknesses of 2.3m which was infilled over 50 years ago and has TOC contents ranging from 1.21 to 2.21%.

25 Geoenvironmental Recommendations

Investigation was not possible in the central area of the site as this was still in use and was occupied by livestock. Further investigation in this area is recommended following the site being vacated. It is also recommend that following demolition of the structures and removal of the hardstanding formation inspections are undertaken.

Investigation across the wider site has not generally encountered contaminant concentrations considered to pose a risk. However, deep made ground of 2.3m and 1.5m was encountered in TP106 and TP111 and in TP106 was found to be impacted with lead and zinc at concentrations considered to pose a risk to human health. Furthermore, the made ground encountered in both pits contained significant anthropogenic materials, is a potential localised source of land gas, and would not be suitable as a growing medium in private gardens or areas of soft landscaping. Geotechnically the made ground may also be subject to significant settlement when loaded. As such some remediation of the infilled pits is required. Allowance should be made for removal of the large bulky items such as washing machine, wood and other organic material. It may be possible to sort and replace the more suitable made ground as backfill, subject to further testing. A clean capping layer may be required in areas of soft landscaping if some of the made ground is to remain.

Following the additional investigation a remediation strategy to mitigate risks to the proposed development from identified contamination should be prepared.

The scope for any additional investigation and remediation strategy should be approved through the planning process prior to their instigation.

A final remediation method statement will be required once the final site designs are complete. This method statement should be submitted to the appropriate regulatory authorities. It is advised that the local authority is informed of the intended build programme in order that they can phase the sign off of planning conditions as required.

It is considered that sufficient topsoil is present onsite to enable the remediation and as such importation of clean topsoil / subsoil is unlikely to be required. Should imported soils be required they should be tested at source by the supplier and, if naturally sourced materials are used, should be imported under either a DoWCoP declaration or waste exemption. Verification should be carried out once the material has been imported.

Provision should also be made for dealing with further localised hotspots of contamination which may come to light during construction. Any such soils should be inspected by the validation engineers and appropriate remedial action taken as necessary.

26 Waste Reduction

26.1 Soil Retention

Soil contains approximately three times as much carbon as the atmosphere. As such minimising its disturbance on site not only minimises the loss of soil for carbon storage but retaining as much soil as possible allows for biodiversity net gain and reduces the risk of surface flooding.

Where possible disturbance of soil functionality during earthworks needs to be minimised. Poorly managed soils that has been compacted in storage will have a degraded physical structure and reduced capacity to maintain above and below ground biodiversity.

The proposed layout indicates public open space is proposed in the southwest of the site, where possible the excavation and disturbance of the soils in these areas should be avoided.

26.2 Soil Reuse

Prior to development, consideration should be given to any on-site materials and their potential for re-use as part of, or during construction of, the proposed development.

26.3 Topsoil Re-use

It is considered than an excess of topsoil will be present on site for the requirement of the proposed development. Site-won topsoil is a resource and should, where possible, be treated as such to prevent damage to the soil structure. Where topsoil is to be stripped, stockpiled and re-used such activities should be undertaken during dry weather (generally June to September). Once stockpiled topsoil should be kept dry. Significant working of topsoil whilst wet can damage the soil structure, reducing the soils' ability to drain and resulting in anaerobic rather an aerobic soil conditions.

Anaerobic soil conditions can have a negative impact on plants and their roots, which will impact the ability of plants to take root once the soil has been placed for its proposed end use. Machinery tracking over recently placed topsoil should be avoided. Should prolonged poor storage result in degradation of the soil some treatment is likely to be required. This may include sand amelioration to improve the soil structure or the addition of composts to reduce nutrient deficiency.

Where an excess of topsoil is anticipated attempt should be made to move this material to other sites where topsoil is required rather than disposing off site as a waste. Movement of clean uncontaminated topsoil from the site would require a Materials Management Plan (MMP) to be produced and declared to CL:AIRE under DoWCoP. Furthermore,, re-use of Made Ground and contaminated natural materials at the site, as well as importation of uncontaminated natural materials will also an MMP to be in place. The declaration is required to be in place before any material movements are made and requires the RMS to have been approved through planning.

27 Waste Disposal

Where there is no further reuse options and soils are to be disposed off-site, it is the duty of the waste producer, in this case Croudace Homes to ensure that all waste is disposed of appropriately and that any that is sent to landfill is sent to an appropriately licensed one. All waste sent to landfill must be classified and must be pre-treated. There are various forms of pre-treatment that are acceptable. In this case it could include "reduction in volume", which could be achieved by segregating the Made Ground and re-using part of it on site.

Where made ground soil is to be re-used on site then it is recommended that this is carried out under the CL:AIRE Definition of Waste Industry Code of Practice (DoWCoP) for re-use of soils[24].

All of the samples tested were screened using the HazWastOnline© tool for preliminary waste classification purposes. It is considered based on this assessment that all but one of the samples tested would be classified as non-hazardous for waste disposal purposes. However, due to the elevated zinc concentration the made ground in TP106 is likely to be classified as hazardous. Confirmatory WAC testing would be required to confirm this and may enable a classification of inert for much of the soils on site.

Further testing and inspection of soils will be required to confirm waste classification of material leaving the site.

It is strongly advised that detailed discussions be held with remediation/groundworks contractors and that receiving landfill sites are identified in advance of commencing any waste removal.

[24] The Definition of Waste: Development Industry Code of Practice. Version 2 2011. CL:AIRE

APPENDIX A – Limitations

Limitations

LIMITATIONS

This report is confidential to the Client and RSK Environment Ltd trading as Leap Environmental and Leap Environmental accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known, unless formally agreed by Leap Environmental beforehand. Any such party relies upon the report at their own risk. Unless explicitly agreed otherwise in writing, this report has been prepared under LEAP's standard terms and conditions, as included in the quotation for this works.

This report has been prepared by Leap Environmental on the basis of information received from a variety of sources which Leap Environmental believes to be accurate. Nevertheless, Leap Environmental cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

Leap Environmental has used all reasonable skill, care and diligence in the design and execution of this report, taking into account the manpower and resources devoted to it in agreement with the Client. Although every reasonable effort has been made to obtain all relevant information, all potential contamination, environmental constraints or liabilities associated with the site may not necessarily have been revealed. LEAP cannot be held responsible for any disclosures or changes in regulation that are provided post production of this report, and will not automatically update the report.

The conclusions reached in this report are necessarily restricted to those which can be determined from the information consulted, and may be subject to amendment in the light of additional information becoming available. These conclusions may not be appropriate for alternative schemes.

The extent of the exploratory holes, laboratory testing and monitoring undertaken may have been restricted due to a number of factors including accessibility, the presence of buried or overhead services, current development and site usage, timescales or client's specification. The exploratory holes only assess a small proportion of the site area with respect to the site as a whole, and as such may only provide an overall assessment of ground conditions on site. The presence of hotspots of undisclosed contamination or exceptional and unforeseen ground conditions cannot be discounted.

Eurocode 7 gives guidance on the type of sampling, sample quality, number and spacing of intrusive investigations, and number of laboratory tests required. It is intended that the Geotechnical Information section of this report will fulfil the general requirements of the Ground Investigation Report as set out in section 6 of Eurocode7[25], although this is subject to the restrictions imposed on the investigation as listed above. For geotechnical design,

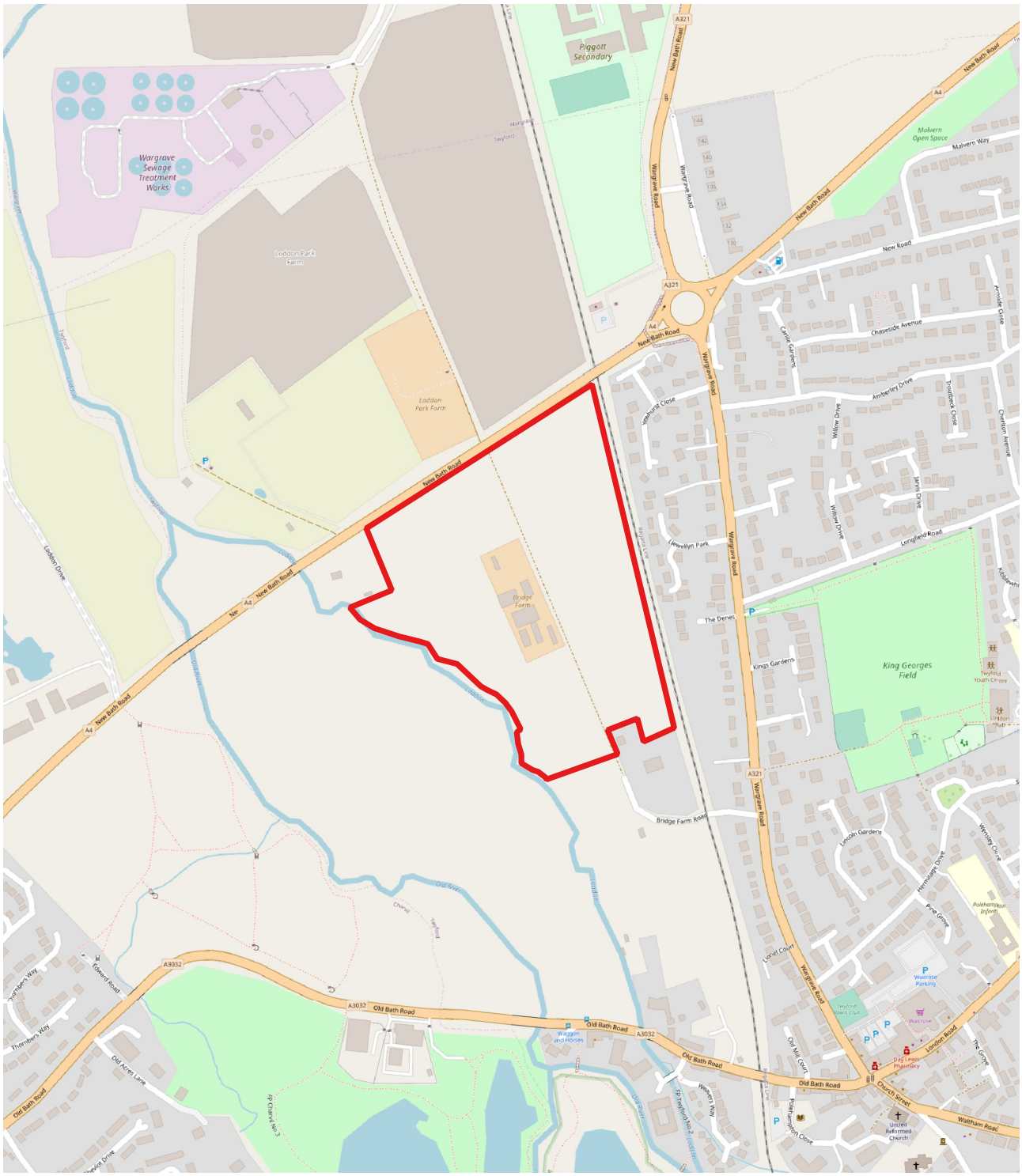
[25] BS EN 1997 Eurocode 7- Geotechnical Design - Part 1: General Rules (2004) and Part 2: Ground Investigation and Testing (2007)

Eurocode 7 requires the Geotechnical Design Report to address both the geotechnical and structural aspects of the geotechnical design for both the limit and serviceability states. The Geotechnical Appraisal section of this report will not meet the requirements of a Geotechnical Design Report (GDR) and should therefore be used for preliminary guidance only.

The presence of asbestos may be noted during the site walkover survey, intrusive investigations and/or from the results of contamination testing. However, this report does not constitute an asbestos survey. On this basis, the presence of asbestos on site cannot be discounted and a full asbestos survey should be undertaken.

APPENDIX B – Figures and Drawings

Figures and Drawings

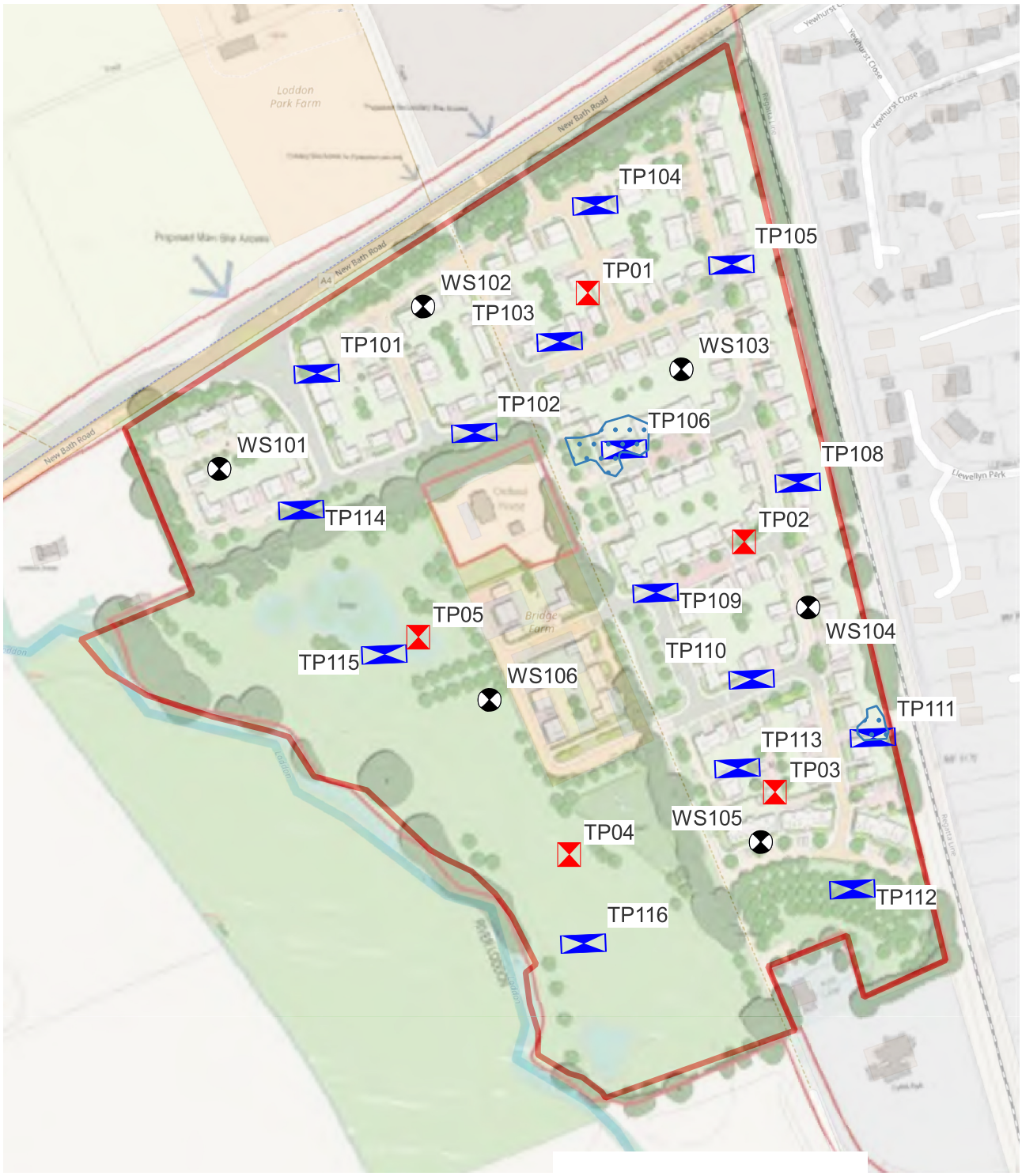


Basemap: © OpenStreetMapcontributors
Note 1: Elevations not shown

Client:	Croudace Homes	Title:	Site Location	Project ID:	LP3302
Project:	Twyford Bridge	Date:	16/05/23	Figure No.	1

Basemap: © OpenStreetMapcontributors
Layout Supplied by the client

leap environmental	Client:	Croudace Homes	Title:	Proposed Layout	Project ID:	LP3302
	Project:	Twyford Bridge	Date:	16/05/23	Figure No.	2



Basemap: © OpenStreetMapcontributors
Layout: Supplied by the client
Note 1 Pits not shown to scale
Note 2 Elevations not shown
Note 3 Gravel pit locations are approximate

Gravel pits

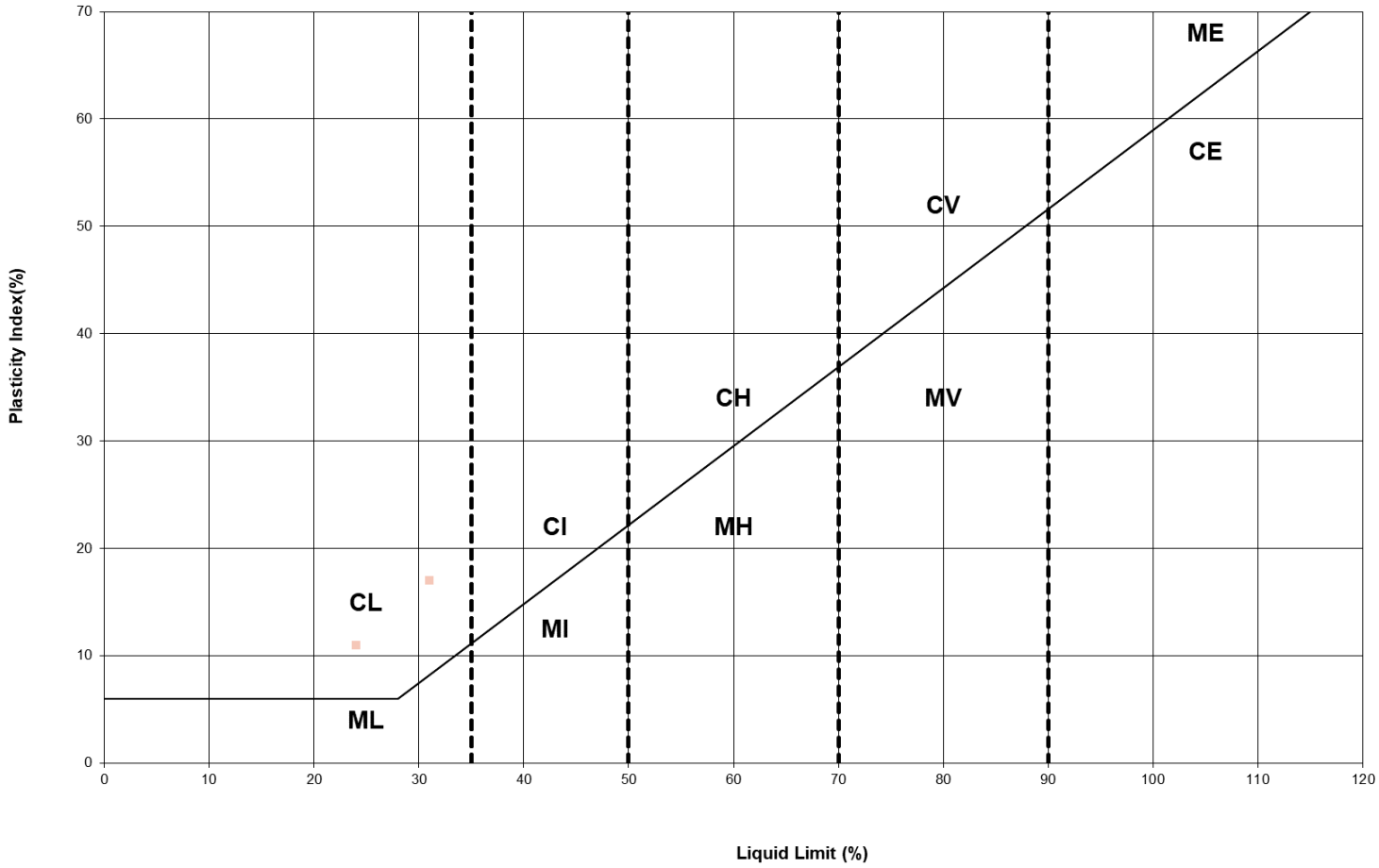
Trial Pit Locations

Windowless sampling locations

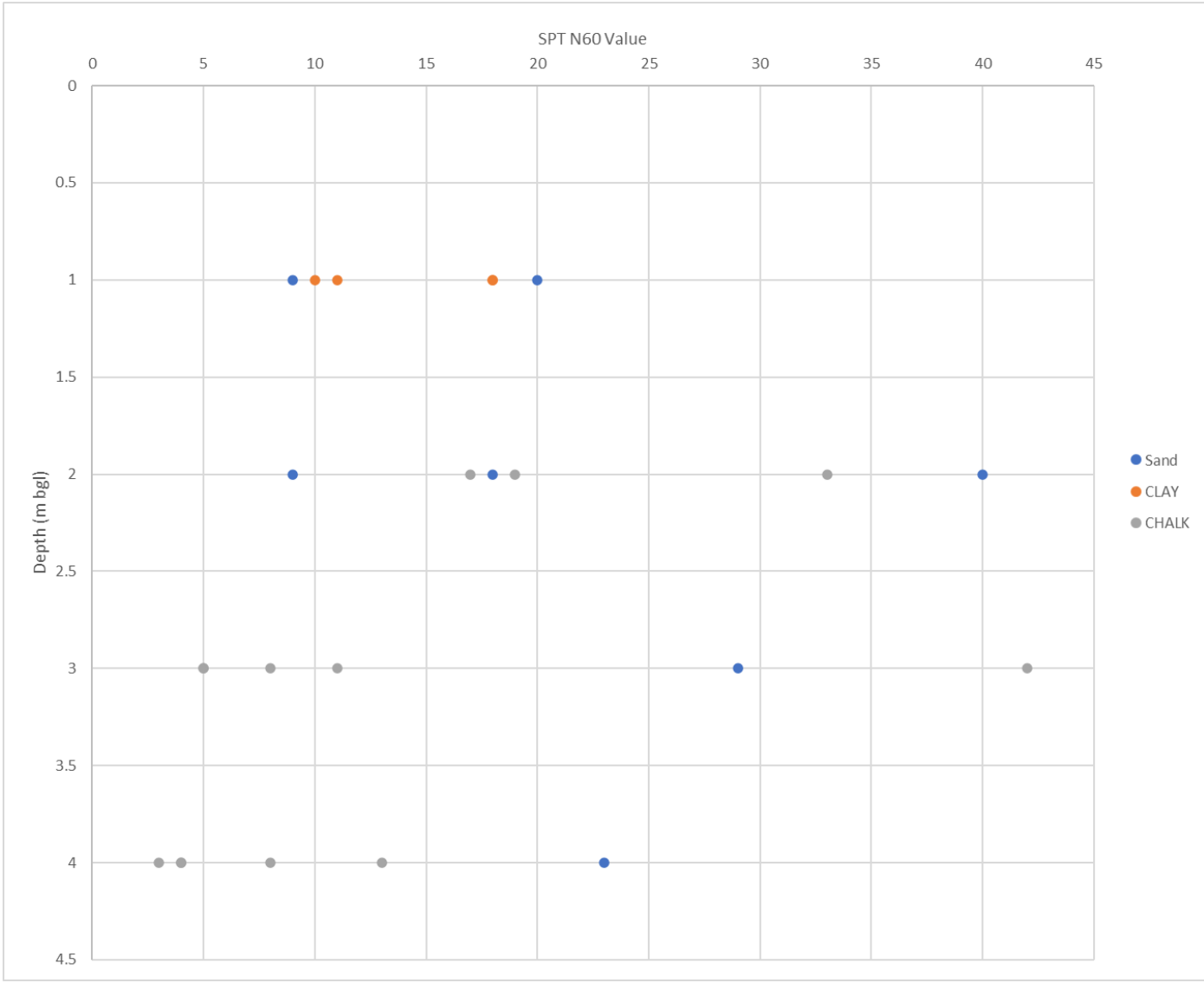
Site Boundary

leap environmental	Client:	Croudace Homes	Title:	SI Locations	Project ID:	LP3302
	Project:	Twyford Bridge	Date:	16/05/23	Figure No.	3

Atterberg Limits A-Line Plot



Client:	Croudace Homes	Date:	16/05/23	Project ID:	LP3302
Project:	Twyford Bridge	Title:	A line Plot	Fig. No.	4



leap environmental	Client:	Croudace Homes	Date:	16/05/23	Project ID:	LP3302
	Project:	Twyford Bridge	Title:	N60 vs Depth	Fig. No.	5

APPENDIX C – Photographic Record

Photographic Record

Plate 1 – Overview of entrance to Twyford Bridge Farm.

Plate 2 – View of overhead storage tanks near farm entrance.

Plate 3 – View of small oil powered generator.

Plate 4 – View of barn, used for storing machinery such as tractors.

Plate 5 – View of second barn, containing farming machinery and caravan.

Plate 6 – Rear view of barns, showing large heap of manure in the left foreground, along with further machinery stored to the right in the open barn.

Plate 7 – Additional barns, housing cattle.

Plate 8 – View of field to the rear of farm with the River Loddon situated on its far border.

Plate 9 – View of old tires piled at the rear of the farm.

Plate 10 – View of second pile of tires at the rear of the barns.

Plate 11 – View of trial pit from above.

Plate 12 – View of arisings from trial pit.

Plate 13 – View of water seepage infilling a trial pit.

Plate 14 – View of trial pit from above.

Plate 15 – View of arisings removed from trial pit.

Plate 16 – View of trial pit from above.

Plate 17 – View of metal debris removed from trial pit.

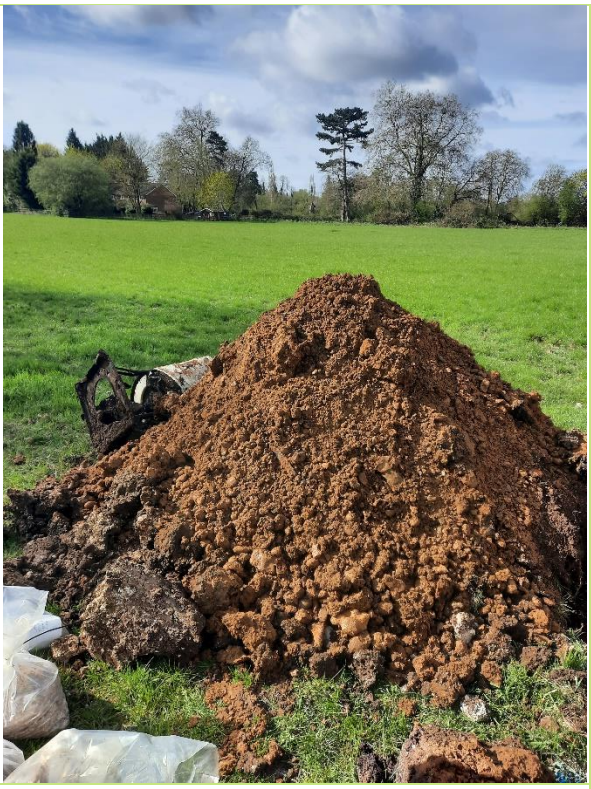


Plate 18 – Second view of arisings and metal debris removed from trial pit.

Plate 19 – Overview of metal debris and arisings removed from trial pit.

APPENDIX D – Preliminary Risk Assessment & Geotechnical Risk Register Tables

Preliminary Risk Assessment & Geotechnical Risk Register Tables

Contaminant	Receptor	Pathway[1]	Likelihood of Exposure	Severity of Exposure	Risk Classification	Notes
All contaminants in soils (Metals, pesticides, PAH and PHC compounds)	Future Residents	Dermal contact, ingestion and inhalation of soil particles	Likely	Mild	Moderate/low risk	The majority of the site is has been mapped as open fields throughout its history with the exception of the centre of the site and the area of two infilled gravel pits. Generally the likelihood of contaminants across the majority of the site is considered low. However, contamination including metals, PAH and PHC compounds and asbestos may be anticipated in the farm yard area and within the backfilled pits. The risk across most of the site is classified as low increasing to moderate in the area of the pits and buildings.
		Consumption of contaminated home grown produce	Likely	Mild	Moderate/low risk	
	Construction workers	Dermal contact, ingestion and inhalation of soil particles	Unlikely	Mild	Very low risk	Construction workers will be exposed to any contaminants present within the ground albeit for a relatively short period of time. Across much of the site limited contamination is anticipated although contaminants are anticipated in the farm yard area and within the infilled pits. The risk to construction workers is considered low to moderate however, assuming appropriate PPE is in use and site hygiene is well maintained the risk is considered to be very low.
	Groundwater (Kempton Park Gravel & Chalk Aquifer's)	Vertical infiltration and leaching from impacted on-site soils	Low likelihood	Medium	Moderate/low risk	The site is underlain by a Secondary A and Principal Aquifer and is situated within the outer Zone of a Groundwater Source Protection Zone. As such, there is the potential for contamination from the site to impact the underlying aquifer. However, it is noted that with the exception of some vehicle storage in the centre of the site no visual evidence to suggest significant free phase/liquid contaminants are present on site has been observed. As such the main would be from metals and pestcides. Therisk is considered low to moderate.

Contaminant	Receptor	Pathway[1]	Likelihood of Exposure	Severity of Exposure	Risk Classification	Notes
	Surface water (River Loddon)	Surface water run-off	Low likelihood	Mild	Low risk	The River Loddon bounds the site to the southwest. As such the potential for any contaminants present on site to impact the river through surface water run-off exists. However, it is noted that the potentially contaminated areas of the site (farm yard and pits) are situated some distance (70m) from the river itself. Given the generally low contaminant concentrations anticipated the risk is considered low
Asbestos fibres in soils	Future Residents	Inhalation of asbestos fibres	Likely	Severe	High risk	Much of the site has been mapped as open fields since the earliest available historical maps as such the risk of asbestos is considered low across the wider site. Potential ACM was noted in the farm yard buildings and there is the potential for asbestos to be present within the infilled pits. The risk is classified a moderate across the wider site and high in the farm yard area due to the severity of the consequences of exposure.
	Construction workers	Inhalation of asbestos fibres	Unlikely	Severe	Moderate/low risk	Construction workers will be exposed to any asbestos present within the ground. However, assuming that appropriate asbestos management strategies are in place, and where works involving asbestos are undertaken by suitably competent contractors using the appropriate the PPE the risk should be low.

Contaminant	Receptor	Pathway[1]	Likelihood of Exposure	Severity of Exposure	Risk Classification	Notes
Soil gases generated from fill materials	Future site users Structures on or adjacent to the site	Vertical and lateral migration through unsaturated pore space. Ingress into buildings via service penetrations, floor construction and cracks, wall cavities, etc. resulting in accumulation in enclosed spaces within buildings. Migration via preferential pathways such as below ground service trenches.	Low likelihood	Mild	Low risk	The nature of the backfill within the two infilled pits is currently unknown. Should the infill material contain significant quantities of degradable material then these pits may represent localised sources of ground gases. Given the generally granular nature of the soils mapped on site a potential pathway for gas migration both vertically and laterally through the soils does exist. It is however, noted that the infilled areas are relatively small and as such unless large quantities of degradable material is present the risk is generally considered to be low.
Pesticides	Future Residents	Dermal contact, ingestion and inhalation of soil particles	Likely	Mild	Moderate/low risk	The site has been agricultural land since the earliest available historical maps. As such it is likely that pesticides have been used on site at some point in its history and may still be present within the shallow soils on site. As such the risk to future site users is classified as moderate.
		Consumption of contaminated home grown produce	Likely	Mild	Moderate/low risk	
	Construction workers	Dermal contact, ingestion and inhalation of soil particles	Unlikely	Mild	Very low risk	Construction workers will be exposed to any contaminants present within the ground albeit for a relatively short period of time. Across much of the site limited contamination is anticipated although contaminants are anticipated in the farm yard area and within the infilled pits. The risk to construction workers is considered low to moderate however, assuming appropriate PPE is in use and site hygiene is well maintained the risk is considered to be very low.

Contaminant	Receptor	Pathway[1]	Likelihood of Exposure	Severity of Exposure	Risk Classification	Notes
	Groundwater (Kempton Park Gravel & Chalk Aquifer's)	Vertical infiltration and leaching from impacted on-site soils	Low likelihood	Medium	Moderate/low risk	The site is underlain by a Secondary A and Principal Aquifer and is situated within the outer Zone of a Groundwater Source Protection Zone. As such, there is the potential for contamination from the site to impact the underlying aquifer. However, it is noted that with the exception of some vehicle storage in the centre of the site no visual evidence to suggest significant free phase/liquid contaminants are present on site has been observed. As such the risk is considered low to moderate.
	Surface water (River Loddon).	Surface water run-off	Likely	Mild	Moderate/low risk	Any pesticides present within the soils have the potential to discharge into the adjacent water course due to surface water run off. Care must be taken to ensure the proposed development does not increase the surface water or sediment inputs from the site into the river.

The classification is based upon the consideration of both the magnitude of consequence and the likelihood of exposure as follows:

Likelihood		Consequence			
		Severe	Medium	Mild	Minor
	High likelihood	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low likelihood	Moderate risk	Moderate/low risk	Low risk	Very Low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

Derived from Annex 4 of NHBC, Environment Agency & CIEH 'Guidance for the Safe Development of Housing on Land Affected by Contamination' R&D66. 2008.

Preliminary Geotechnical Risk Register

Geotechnical risk is the risk to building and construction work created by the site ground conditions. The Preliminary Geotechnical Risk Register has been compiled to provide an assessment of the likely risks that may impact on the proposed development based on the results of the desk study, and should be used to specify the type and extent of the intrusive investigation and testing undertaken, and to identify potential mitigation measures to control the risk to an acceptable level.

The inclusion of a risk in the register does not indicate that the risk is present, rather the likelihood of mitigation measures being required due to that risk, based on the available data. Equally, a risk classified as low indicates that mitigation measures are unlikely to be required for the hazard identified based on the available data.

The risk register should be developed and refined throughout the design process such that it will enable the management of geotechnical risk.

The Geotechnical Risk Register has been developed in accordance with the guidance presented in ICE/DETR Document "Managing Geotechnical Risk" (2002). The degree of risk (R) is determined by assessing the likelihood of a hazard (L) occurring and the effect of the hazard (E) on the project (R=LxE). The effect may be measured in one or more aspect e.g. increased cost, delays in the program, health and safety etc. The scale of the likelihood, effect and risk are determined as follows:-

Likelihood of Occurrence		
Scale	Likelihood	Chance
4	Probable	>1 in 2
3	Likely	1 in 10 to 1 in 2
2	Unlikely	1 in 100 to 1 in 10
1	Negligible	<1 in 100

x

Effect of Hazard		
Scale	Effect	Increase in cost or time
4	Very High	>10%
3	High	4-10%
2	Low	1-4%
1	Very Low	<1%

=

Degree of Risk		
Degree of Risk	Risk Level	Action required
1-4	Low	None
5-8	Significant	Consider cost effective solutions or improvements at no extra cost
9-12	Substantial	Work must not start until risk has been reduced. Additional resource required
13-16	Intolerable	Work must not start until risk has been reduced. If risk can not be reduced, project should not proceed.

Hazard	Effect	Likelihood of Occurrence	Effect of Hazard	Risk Classification	Notes
Made Ground	Deepened foundations	Likely	Low	Significant	Two infilled gravel pits are located in the west of the site. Made ground is not suitable as a load bearing stratum and as such some deepening of foundations is likely to be required in this area. Excavations within the made ground is likely to be unstable even in the short term.
	Unstable excavations	Likely	Low	Significant	
Compressible Ground	Bearing capacity failure	Unlikely	High	Significant	The development potion of the site is underlain by the Kempton Park Gravel over the White Chalk Subgroup. These natural soils are not deemed to be excessively compressible. Although loose/soft soils at the Superficial / Chalk boundary may be anticipated. The southwest of the site is mapped as being underlain by Alluvial deposits which are likely to be poor consolidated. At this stage these soils are not believed to extend into the development portion of the site however, should such soils be encountered then settlement should be anticipated.
	Excessive settlement	Unlikely	High	Significant	
High Groundwater Table	Unstable excavations/ running sands	Likely	High	Substantial	The site is situated adjacent to the river and is underlain by the Kempton Park Gravel and Chalk Aquifers. Previous pits on site recorded groundwater seepages at around 2.0m bgl in the spring. Running sands / gravels should be anticipated within the granular soils where excavations extend below the water table. If deep excavations are proposed on site allowance for dewatering should be in place.
	Dewatering	Likely	High	Substantial	
Deep Excavations	Deepened foundations	Likely	High	Substantial	Two infilled gravel pits are present on site. The nature of the infill material is currently unknown but is unlikely to be suitable as a load bearing stratum and as such foundations in these areas are likely to require deepening.
Working in highway	Traffic Management	Negligible	Very low	Trivial	N/A

Shrinkable soils	Deepened foundations	Unlikely	High	Significant	The Kempton Park Gravels generally comprised granular soils. However, localised pockets of cohesive soils may be anticipated. It is not anticipated that these soils if present will exhibit particularly high plasticity however some foundation deepening may be required should these soils be encountered near trees.
	Heave	Negligible	High	Trivial	
Frost Susceptible soils	Road Design	Likely	Low	Significant	Soils on-site are not deemed frost susceptible.
Aggressive ground conditions for Concrete	Concrete design	Unlikely	Low	Trivial	The soils on site are not listed among those as potentially containing pyrite within the BRE Special Digest on aggressive ground conditions.
Slope Stability / Retaining Structure	Local stability	Negligible	High	Trivial	Site is relatively level. Unless significant cut and fill activities are proposed on site the risk is considered low.
	Global stability	Negligible	High	Trivial	
Ground dissolution/ Natural cavities	Remedial measures	Likely	High	Substantial	The site is underlain by Superficial deposits over the Chalk at depth. The boundary between the Kempton Park Gravel and Alluvium is present on site and the boundary with the Lambeth Group is mapped ~400m to the east and south of the site. Solution features are more prevalent near geological boundaries.
Archaeological remains	Remedial measures	Negligible	High	Trivial	LEAP is not aware of any such features on site.
UXO	UXO supervision	Negligible	Very high	Trivial	UXO risk has been deemed Low based on the Zetica Risk Mapping.

APPENDIX E – Exploratory Logs

Exploratory Logs

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Trial Pit Log

Trialpit No
TP101
Sheet 1 of 1

Project Name:	Twyford Bridge Farm	Project No. LP3302	Co-ords: 478211 - 176767 Level: 38.25
Location:	Twyford Bridge Farm, Reading, RG10 9PP	Dimensions (m): Depth 2.90	Date 12/04/2023 Scale 1:25
Client:	Croudace Homes Ltd (Caterham)		Logged ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES					Grass over brown silty sandy TOPSOIL with rootlets and occasional medium to coarse subrounded flint.
	0.35	ES		0.30	37.94		Brown to orange brown slightly clayey slightly gravelly silty sandy SUBSOIL. Gravel is medium to coarse occasionally cobbled subangular to rounded flint.
				0.70	37.54		Brown to orange brown slightly silty sandy flint GRAVEL with pockets of gravelly sand. Gravel is fine to coarse occasionally cobble sized subangular to rounded flint. *Gravel slightly coarsening with depth.*
	1.10	B					
	2.40	B					*recovered as wet at 2.3m bgl.*
				2.90	35.34		End of pit at 2.90 m

Remarks: Trial pit remained dry with sides of the pits collapsing within the gravels from 0.7m bgl. Trial pit was backfilled with arisings upon completion.

Stability: Unstable

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Trial Pit Log

Trialpit No
TP102
Sheet 1 of 1

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478290 - 176737 Level: 37.87	Date 12/04/2023
Location: Twyford Bridge Farm, Reading, RG10 9PP		Dimensions (m): Depth 3.00	Scale 1:25
Client: Croudace Homes Ltd (Caterham)			Logged ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES		0.20	37.67		Grass over brown slightly silty slightly gravelly TOPSOIL. Gravel is fine to coarse subrounded flint, and brick fragments noted.
	0.40	ES					Brown mottled dark brown and orange brown REWORKED slightly gravelly sandy clayey subsoil. Gravel of medium to coarse subrounded to rounded flint and rare fine concrete and brick.
				0.60	37.27		Light brown to orange brown slightly gravelly silty SAND. Gravel is medium to cobbled subrounded to rounded flint.
	1.20	B					
	1.80	D					*Pockets of stiff brown to orange brown very sandy clay below from 1.7m bgl* *Hand Pen UCS at 1.8m = 180kPa*
				2.70	35.17		Orange brown slightly silty fine SAND with rare to occasional flint cobbles with mottled orange and grey very sandy clay.
	2.90	B					*Hand Pen UCS at 2.8m = 140kPa*
				3.00	34.87		End of pit at 3.00 m

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Remarks: Trial pit remained dry and stable and was backfilled with arisings upon completion.

Stability: stable

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Trial Pit Log

Trialpit No
TP103
Sheet 1 of 1

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478333 - 176783 Level: 38.18	Date 11/04/2023
Location: Twyford Bridge Farm, Reading, RG10 9PP		Dimensions (m): Depth 3.10	Scale 1:25
Client: Croudace Homes Ltd (Caterham)			Logged LP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES		0.30	37.88		Grass over slightly sandy silty TOPSOIL with gravels of flint.
	0.80	D					Firm orange sandy gravelly silty CLAY with pockets of fine sand. Gravel of subangular to rounded medium to coarse flint.
	1.80	D		1.70	36.48		Orange to orange brown gravelly fine SAND with pockets of firm to stiff sandy clay. Gravel of fine to coarse subrounded to rounded flint and rootlets present. *Hand Pen UCS at 1.8m = 220kPa*
	2.30	B					*Off white patches present at 2.4m bgl.*
	2.90	D		2.70	35.48		Light brown and off white silty gravelly SAND. Sand is fine. Gravel is fine to medium chalk and fine to coarse flint.
				3.10	35.08		End of pit at 3.10 m

Remarks: Trial pit remained dry and stable and was backfilled with arisings upon completion.

Stability: stable

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Trial Pit Log

Trialpit No
TP104
Sheet 1 of 1

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478351 - 176852 Level: 38.17	Date 11/04/2023
Location: Twyford Bridge Farm, Reading, RG10 9PP		Dimensions (m): Depth 2.80	Scale 1:25
Client: Croudace Homes Ltd (Caterham)			Logged ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.30	37.87		Grass over brown slightly gravelly slightly silty sand TOPSOIL. Gravel is medium to coarse subrounded flint.
	0.80	D					Firm orange brown slightly gravelly slightly sandy CLAY. Gravel is fine to coarse rounded flint. *Rootlets noted at 0.5m bgl.* *Hand Pen UCS at 0.9m = 140kPa*
	1.50	D		1.00	37.17		Off white and light brown slightly sandy gravelly SILT with brown slightly sandy slightly gravelly clay pockets. Gravel is fine to coarse frequent cobbled sized flint. *Hand Pen UCS at 1.4m = 140kPa* *Becoming more gravelly with depth.*
	2.30 - 2.60	B		1.80	36.37		Off white slightly sandy silty GRAVEL. Gravel is medium to cobbled flint and medium chalk.
				2.80	35.37		End of pit at 2.80 m

Remarks: Trial pit remained dry and stable and was backfilled with arisings upon completion. The pit was terminated at 2.8 due to no further progress within the dense gravel.

Stability: stable

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Trial Pit Log

Trialpit No
TP105
Sheet 1 of 1

Project Name:	Twyford Bridge Farm	Project No. LP3302	Co-ords: 478419 - 176822 Level: 37.91
Date	11/04/2023		
Location:	Twyford Bridge Farm, Reading, RG10 9PP	Dimensions (m): Depth 3.00	Scale 1:25
Client:	Croudace Homes Ltd (Caterham)		Logged ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES		0.30	37.61		Grass over brown slightly silty slightly gravelly sandy TOPSOIL. Gravel is medium to coarse rounded flint.
	1.30	B					Brown to orange brown slightly gravelly slightly clayey fine SAND. Gravel is fine to coarse occasionally cobble sized rounded flint.
	2.00	D		2.20	35.71		Firm brown to orange brown thinly laminated very sandy slightly gravelly CLAY. *Hand Pen UCS at 2.3m = 70kPa*
	2.60	D					*Hand Pen UCS at 2.6m = 140kPa*
	2.90	D		2.80 3.00	35.11 34.91		Firm to stiff orange brown and grey mottled thinly laminated sandy to very sandy CLAY with rare flint gravel. *Hand Pen UCS at 2.8m = 150kPa* End of pit at 3.00 m

Remarks: Trial pit remained dry and stable and was backfilled with arisings upon completion.

Stability: stable

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Trial Pit Log

Trialpit No
TP106
Sheet 1 of 1

Project Name:	Twyford Bridge Farm	Project No. LP3302	Co-ords: 478365 - 176729 Level: 37.82
Location:	Twyford Bridge Farm, Reading, RG10 9PP	Dimensions (m): Depth 3.15	
Client:	Croudace Homes Ltd (Caterham)		

Date: 11/04/2023
Scale: 1:25
Logged: LP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES					Grass over brown sandy gravelly silty TOPSOIL with fine to coarse gravel of flint.
				0.30	37.52		MADE GROUND: Orange silty gravelly sand. Sand is fine. Gravel is fine to cobble sized chalk and flint.
	0.50	D					
				2.00	35.82		Dark brown mottled black green and white gravelly sandy clayey MADE GROUND. Gravel of fine to coarse subrounded to rounded flint, fine chalk, metal, tar, wood, wire, canisters and rubber.
	2.10	ES					
				2.30	35.52		Firm brown mottled dark brown silty sandy CLAY.
							Fine chalk gravel from 2.9m bgl.
	3.00	B					
				3.15	34.67		End of pit at 3.15 m

Remarks: Trial pit remained dry with the sides of the pits collapsing within the clay. The pit was backfilled with arisings upon completion.

Stability: Unstable

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Trial Pit Log

Trialpit No
TP108
Sheet 1 of 1

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478452 - 176712 Level: 37.46	Date 11/04/2023
Location: Twyford Bridge Farm, Reading, RG10 9PP		Dimensions (m): Depth 3.00	Scale 1:25
Client: Croudace Homes Ltd (Caterham)			Logged ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.30	37.16		Grass over brown slightly gravelly to gravelly silty sandy TOPSOIL. Gravel is coarse rounded flint.
				0.60	36.86		Brown to orange brown slightly gravelly sandy clayey SUBSOIL. Gravel of medium to coarse subrounded flint.
	1.20	B					Brown to light brown sandy to very sandy GRAVEL. Gravel of fine to coarse subrounded to rounded flint.
	1.80	D		1.70	35.76		Off white mottled brown to orange brown gravelly SILT and sandy clay (Chalk Head). *Chalk gravel becoming more prevalent with depth.*
	2.80	D		3.00	34.46		End of pit at 3.00 m

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Remarks: Trial pit remained dry and stable and was backfilled with arisings upon completion.

Stability: stable

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Trial Pit Log

Trialpit No
TP109
Sheet 1 of 1

Project Name:	Twyford Bridge Farm	Project No. LP3302	Co-ords: 478381 - 176657 Level: 37.19
Location:	Twyford Bridge Farm, Reading, RG10 9PP	Dimensions (m): Depth 2.90	
Client:	Croudace Homes Ltd (Caterham)		

Date: 11/04/2023
Scale: 1:25
Logged: ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.15	ES					Grass over brown slightly gravelly silty sand TOPSOIL. Gravel is medium to coarse subrounded flint.
	0.35	ES		0.35	36.84		Brown to orange brown slightly silty sandy GRAVEL. Gravel is fine to coarse occasionally cobble sized subrounded flint. Sand is fine to coarse.
	1.10	B					
	1.80	D					*Pockets of gravelly sand from 1.7m bgl.*
	2.50	B					
				2.90	34.29		End of pit at 2.90 m

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Remarks: Trial pit remained dry with the sides of the pits collapsing within the gravel and was terminated due to no further progress at 2.9m depth. The pit was backfilled with arisings upon completion.

Stability: Unstable

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Trial Pit Log

Trialpit No
TP110
Sheet 1 of 1

Project Name:	Twyford Bridge Farm	Project No. LP3302	Co-ords: 478429 - 176614 Level: 36.77
Location:	Twyford Bridge Farm, Reading, RG10 9PP	Dimensions (m): Depth 2.90	Date 11/04/2023 Scale 1:25
Client:	Croudace Homes Ltd (Caterham)		Logged ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.30	36.47		Gras over brown slightly silty sandy TOPSOIL with occasional flint gravel and rootlets.
	0.40	ES					Brown to orange brown slightly gravelly sandy clay SUBSOIL. Gravel is medium to coarse subrounded to rounded flint.
	0.80	D	HVP=88	0.55	36.22		Stiff to firm brown to orange brown slightly gravelly sandy CLAY. Sand is fine, gravel is medium to coarse flint and rare medium chalk. *Becoming sandier with depth.* *Hand Pen at 0.7m = 80kPa*
				1.20	35.57		Off white to white CHALK recovered as gravelly silt. Gravel is fine to medium Grade Dc chalk. *Chalk in north west end of the pit at 1.2m bgl.* *Too sandy for shear vane test at 1.2m bgl.*
	2.30 2.30	D D					*Gravel is medium to coarse from 2.8m bgl.*
				2.90	33.87		End of pit at 2.90 m

1 2 3 4 5

Remarks: Trial pit remained stable with a groundwater seepage at 2.9m bgl. Trial pit was backfilled with arisings upon completion.

Stability: stable

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Trial Pit Log

Trialpit No
TP111
Sheet 1 of 1

Project Name:	Twyford Bridge Farm	Project No. LP3302	Co-ords: 478490 - 176585 Level: 36.61	Date 11/04/2023
Location:	Twyford Bridge Farm, Reading, RG10 9PP		Dimensions (m): Depth 2.30	Scale 1:25
Client:	Croudace Homes Ltd (Caterham)			Logged ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES		0.20	36.41		Grass over brown reworked gravelly silty sandy MADE GROUND. Gravel is coarse to whole brick, concrete, plastic, metal, tarmac and concrete.
	0.55	ES					MADE GROUND comprising brown mottled white and brick red slightly sandy clayey gravel. Gravel is brick, metal, plastic and wood along with waste including electronics and washing machine parts.
	1.60	B		1.50	35.11		Orange to orange brown slightly clayey sandy GRAVEL. Gravel is fine to coarse occasionally cobble sized subangular to rounded flint.
	1.60	ES					*Damp to touch at 1.8m bgl.*
				2.30	34.31		End of pit at 2.30 m

Remarks: Trial pit was terminated at 2.3m depth due to the sides collapsing, and was backfilled with arisings upon completion.

Stability: Unstable

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Trial Pit Log

Trialpit No
TP112
Sheet 1 of 1

Project Name:	Twyford Bridge Farm	Project No. LP3302	Co-ords: 478480 - 176508 Level: 35.49
Location:	Twyford Bridge Farm, Reading, RG10 9PP	Dimensions (m): Depth 1.80	
Client:	Croudace Homes Ltd (Caterham)		

Date: 11/04/2023
Scale: 1:25
Logged: ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES		0.20	35.29		Grass over brown slightly gravelly silty sandy TOPSOIL. Gravel is medium to coarse subrounded to rounded flint.
	0.35	ES					Brown to orangish brown slightly silty clayey sandy SUBSOIL. Gravel is medium to coarse subrounded to rounded flint.
	0.50	B		0.45	35.04		*Rootlets to 0.35m.*
				0.80	34.69		Orange-brown to brown slightly clayey sandy GRAVEL. Gravel is medium to coarse with occasional cobble sized flint.
	1.10	D		1.60	33.89		White to off white SILT with pockets of brown sandy clay with rare coarse flint.
	1.70	D		1.80	33.69		Off white CHALK recovered as silty gravel with occasional medium to coarse flint.
							Rapid groundwater seepage at 1.6m, water level rose by 5cm in 5 minutes.
							End of pit at 1.80 m

Remarks: Trial pit was terminated at 1.8m due to the sides collapsing. Rapid groundwater seepage at 1.6m. Trial pit was backfilled with arisings upon completion.

Stability: Unstable

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Trial Pit Log

Trialpit No
TP113
Sheet 1 of 1

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478422 - 176569 Level: 36.63	Date 11/04/2023
Location: Twyford Bridge Farm, Reading, RG10 9PP		Dimensions (m): Depth 2.90	Scale 1:25
Client: Croudace Homes Ltd (Caterham)			Logged ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.15	ES					Grass over brown silty sandy TOPSOIL with rootlets and with occasional medium to coarse rounded flint gravel.
	0.40	ES		0.30	36.33		Orange brown slightly sandy to sandy, slightly gravelly clayey SUBSOIL. Gravel is fine to coarse subrounded to rounded flint.
	0.80	D		0.60	36.03		Off white mottled brown slightly sandy silty flint GRAVEL. With pockets of orange brown to brown sandy clay. *Hand Pen UCS at 0.8m = 210kPa.*
	1.50	B					*Hand Pen UCS at 1.8m = 200kPa.*
	2.00	D		1.90	34.73		Light orange brown clayey slightly sandy GRAVEL. Gravel is medium to coarse subrounded flint with stiff clay pockets.
	2.80	D		2.70	33.93		Off white completely weathered CHALK recovered as slightly gravelly silt. Grade DM. Gravel is medium to coarse subrounded to rounded flint and fine low density chalk.
				2.90	33.73		End of pit at 2.90 m

Remarks: Trial pit remained dry and stable and was backfilled with arisings upon completion.

Stability: stable

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Trial Pit Log

Trialpit No
TP114
Sheet 1 of 1

Project Name:	Twyford Bridge Farm	Project No. LP3302	Co-ords: 478203 - 176699 Level: 37.58
Location:	Twyford Bridge Farm, Reading, RG10 9PP	Dimensions (m): Depth 2.80	
Client:	Croudace Homes Ltd (Caterham)		

Date: 11/04/2023
Scale: 1:25
Logged: ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.15	ES					Grass over brown slightly gravelly silty sandy TOPSOIL. Gravel is medium to coarse subrounded to rounded flint.
	0.40	ES		0.30	37.28		Orange brown mottled off white slightly sandy slightly gravelly clay SUBSOIL.
				0.50	37.08		Light brown mottled off white slightly sandy silty very gravelly to gravelly CLAY. Gravel is medium to coarse subrounded to subangular chalk and fine to cobble sized flint.
							Slight groundwater seepage at 1.0m
	1.20	D					*Colour change to orange brown and off white below 1.2m.*
				1.30	36.28		Orange brown mottled off white slightly sandy to sandy gravelly silty CLAY. Gravel is medium to cobble sized flint and medium to coarse occasional cobble sized chalk.
				1.80	35.78		Orange brown and off white silty sandy GRAVEL. Gravel is medium to coarse with frequent cobble sized subrounded to rounded flint and fine to medium chalk.
	2.00	D					
				2.20	35.38		White to off white highly to completely weathered CHALK. Recovered as very silty gravel of chalk and frequent flint. Grade DM.
	2.30	D					
	2.50	D					
				2.60	34.98		Off white CHALK with frequent flint cobbles. Recovered as gravelly silt. Grade Dc.
				2.80	34.78		End of pit at 2.80 m

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Remarks: Trial pit remained stable, with slight groundwater seepage below 1.0m. Trial pit was backfilled with arisings upon completion. No further progress below 2.8m.

Stability: stable

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Trial Pit Log

Trialpit No
TP115
Sheet 1 of 1

Project Name:	Twyford Bridge Farm	Project No. LP3302	Co-ords: 478245 - 176626 Level: 35.87
Location:	Twyford Bridge Farm, Reading, RG10 9PP	Dimensions (m): Depth 3.20	
Client:	Croudace Homes Ltd (Caterham)		

Date: 11/04/2023
Scale: 1:25
Logged: ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.30	35.57		Grass and weeds over brown silty sandy TOPSOIL with rootlets and occasional medium to coarse rounded flint gravel.
	0.50	ES					Brown to orange brown slightly silty sandy clayey SUBSOIL with occasional medium to coarse subrounded to rounded flint gravel.
			HVP=69	0.65	35.22		Stiff orange brown slightly sandy to sandy CLAY with occasional flint gravel. *Frequent flint cobbles present below 1.0m.*
	2.00	B		1.65	34.22		Brown to orange brown slightly silty fine SAND with rare medium subangular flint with pockets of sandy to very sandy clay.
				2.40	33.47		Orange brown silty fine SAND with occasional fine to medium flint gravel. With pockets of silty gravelly chalk head.
				2.80	33.07		Off white completely weathered CHALK with cobble sized subrounded to rounded flint. *Slight groundwater seepage at 2.8m.*
	3.20	D		3.20	32.67		End of pit at 3.20 m

1 2 3 4 5

Remarks: Trial pit terminated at 3.2m due to the sides collapsing. Slight groundwater seepage at 2.8m. Trial pit backfilled with arisings upon completion.

Stability: Unstable

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Trial Pit Log

Trialpit No
TP116
Sheet 1 of 1

Project Name:	Twyford Bridge Farm	Project No. LP3302	Co-ords: 478345 - 176481 Level: 34.79
Location:	Twyford Bridge Farm, Reading, RG10 9PP	Dimensions (m): Depth 2.40	Date 11/04/2023 Scale 1:25
Client:	Croudace Homes Ltd (Caterham)		Logged ADC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.15	ES		0.25	34.54		Grass and weeds over orange brown clayey sandy TOPSOIL with occasional medium to coarse subrounded flint gravel.
	0.40	ES					Orange brown slightly clayey slightly gravelly sandy SUBSOIL. Gravel is medium to coarse subangular to subrounded flint gravel.
	1.20	D	HVP=16	0.90	33.89		Soft to firm light brown mottled orange brown slightly silty slightly sandy CLAY with occasional coarse rounded to subrounded flint. *Sides of trial pit collapsing below 1.0m.*
	2.00	D		1.40	33.39		Soft to firm mottled grey, dark brown and orange brown slightly silty slightly sandy CLAY with pockets of sand. Sand is medium grained, gravel of rare medium to coarse subrounded to rounded flint. *Hand Pen UCS at 2.1m = 140kPa*
	2.30	D					*Hand Pen UCS at 2.3m = 120kPa*
				2.40	32.39		End of pit at 2.40 m

1 2 3 4 5

Remarks: Trial pit terminated at 2.4m depth due to sides collapsing, slight groundwater seepage at 1.0m. Trial pit was backfilled with arisings upon completion.

Stability: Unstable

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Borehole Log

Borehole No.
WS101
Sheet 1 of 2

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478162 - 176714	Hole Type WS
Location: Twyford Bridge Farm, Reading, RG10 9PP		Level: 37.74	Scale 1:20
Client: Croudace Homes Ltd (Caterham)		Dates: 12/04/2023 - 12/04/2023	Logged By IA

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES					Grass over TOPSOIL: Brown sandy slightly gravely silt. Sand is fine. Gravel is fine to medium angular to subrounded flint.
					0.40	37.34		Orange brown sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium angular to subrounded flint.
					0.70	37.04		Loose becoming more dense orange brown slightly clayey SAND. Sand is medium to coarse
		0.80	D					
		1.00		N=7 (1,2/2,2,1,2)				
		2.00		N=13 (2,2/4,2,4,3)				
					2.10	35.64		Off white CHALK. Recovered as whitish brown clayey gravel of chalk. Gravel is fine to coarse, angular to subangular chalk and flint.
		2.20	D					
		3.00		N=6 (2,1/1,2,1,2)				
		3.50	D					
		4.00		N=3 (1,1/0,1,1,1)				

Continued on next sheet

Remarks
Borehole remained dry and stable. Borehole was backfilled with arisings to 3.0m. Install comprised 1.0m plain pipe with bentonite surround over 2.0m slotted pipe with gravel surround. No SPT at 5.0m due to insufficient number of drill rods. SPT hammer ratio 76.66%.

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Borehole Log

Borehole No.
WS101
Sheet 2 of 2

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478162 - 176714	Hole Type WS
Location: Twyford Bridge Farm, Reading, RG10 9PP		Level: 37.74	Scale 1:20
Client: Croudace Homes Ltd (Caterham)		Dates: 12/04/2023 - 12/04/2023	Logged By IA

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					5.00	32.74		End of borehole at 5.00 m

Remarks
Borehole remained dry and stable. Borehole was backfilled with arisings to 3.0m. Install comprised 1.0m plain pipe with bentonite surround over 2.0m slotted pipe with gravel surround. No SPT at 5.0m due to insufficient number of drill rods. SPT hammer ratio 76.66%.

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Borehole Log

Borehole No.
WS102
Sheet 1 of 1

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478264 - 176796	Hole Type WS
Location: Twyford Bridge Farm, Reading, RG10 9PP		Level: 38.69	Scale 1:20
Client: Croudace Homes Ltd (Caterham)		Dates: 12/04/2023 - 12/04/2023	Logged By IA

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES					Grass over TOPSOIL: Brown sandy slightly gravelly SILT. Gravel is fine to medium angular to subrounded flint.	
					0.40	38.29		Orange brown clayey slightly gravelly SAND. Sand is fine to medium . Gravel is fine to medium angular to subrounded flint with occasional cobbles.	
		0.90	D						
		1.00		N=14 (2,2/3,3,4,4)	1.00	37.69		Orange brown sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to coarse, angular to subrounded flint.	1
					1.50	37.19		Medium dense orange brown gravelly SAND. Sand is medium to coarse. Gravel is fine to coarse, angular to subangular flint.	
		1.80	D						
		2.00		N=31 (3,7/8,7,8,8)					2
					2.90	35.79		Medium dense orange brown grey slightly clayey SAND. Sand is medium to coarse. Gravel is fine to coarse, angular to subrounded flint.	
		3.00		N=23 (4,5/5,5,6,7)					3
		4.00		N=18 (4,4/5,4,4,5)	4.00	34.69		End of borehole at 4.00 m	4

Remarks
Borehole remained dry and stable and was backfilled with arisings upon completion. SPT hammer ratio 76.66%.

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Borehole Log

Borehole No. **WS103**
Sheet 1 of 1

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478394 - 176764	Hole Type WS
Location: Twyford Bridge Farm, Reading, RG10 9PP		Level: 38.02	Scale 1:20
Client: Croudace Homes Ltd (Caterham)		Dates: 12/04/2023 - 12/04/2023	Logged By IA

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES					Grass over TOPSOIL: Brown sandy slightly gravelly SILT. Sand is fine. Gravel is fine to medium subangular to subrounded flint
					0.35	37.67		Reddish brown sandy slightly gravelly CLAY. Sand is fine to medium gravel is fine to medium angular to subrounded flint with occasional cobbles.
		0.75	D					
		1.00		N=8 (1,1/2,2,2,2)				
					1.60	36.42		Orange brown slightly gravelly SAND. Sand is medium. Gravel is fine to coarse subrounded to rounded flint.
		1.75	D					
		2.00	D		2.00	36.02		Medium dense to dense orange brown gravel SAND. Sand is medium to coarse. Gravel is fine to coarse angular to subrounded flint.
		2.00		N=14 (4,5/5,3,3,3)				
		3.00		N=33 (2,7/8,8,8,9)				
					3.10	34.92		Off white silty gravelly CHALK. Gravel is fine to medium angular to subangular flint and chalk.
		3.70	D					
		4.00		N=6 (1,2/1,2,1,2)	4.00	34.02		End of borehole at 4.00 m

Remarks
Borehole remained dry and stable. Borehole was backfilled with arisings to 3.0m. Install comprised 1.0m plain pipe with bentonite surround over 2.0m slotted pipe with gravel surround. SPT hammer ratio 76.66%.

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Borehole Log

Borehole No. **WS104**
Sheet 1 of 1

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478458 - 176796	Hole Type WS
Location: Twyford Bridge Farm, Reading, RG10 9PP		Level: 37.78	Scale 1:20
Client: Croudace Homes Ltd (Caterham)		Dates: 12/04/2023 - 12/04/2023	Logged By IA

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES					Grass over TOPSOIL: Brown sandy slightly gravelly silt. Sand is fine. Gravel is fine to medium angular to subangular flint.
		0.30	ES					
					0.40	37.38		Medium dense orange brown very gravelly medium SAND. Sand is medium to coarse. Gravel is fine to coarse subrounded to rounded flint.
		1.00 1.00	D	N=16 (2,6/5,4,4,3)				
					1.70	36.08		Off white silty CHALK recovered as silty gravel. Gravel is fine to coarse, angular to subangular flint and chalk.
		2.00 2.00	D	N=7 (2,2/2,2,2,1)	2.00	35.78		Loose orange brown very gravelly medium to coarse SAND. Gravel is fine to coarse subrounded to rounded flint.
					2.90	34.88		Off white highly weathered chalk recovered as SILT.
		3.00		N=9 (1,1/2,2,1,4)				
		3.50	D					
		4.00		N=10 (1,0/2,3,2,3)	4.00	33.78		End of borehole at 4.00 m

Remarks
Borehole remained dry and stable and was backfilled with arisings upon completion. SPT hammer ratio 76.66%.

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Borehole Log

Borehole No.
WS105
Sheet 1 of 1

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478434 - 176714	Hole Type WS
Location: Twyford Bridge Farm, Reading, RG10 9PP		Level: 35.92	Scale 1:20
Client: Croudace Homes Ltd (Caterham)		Dates: 12/04/2023 - 12/04/2023	Logged By IA

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES					Grass over TOPSOIL: Brown sandy gravelly silt. Sand is fine to medium. Gravel is fine to medium angular to subrounded flint.
					0.30	35.62		Firm to stiff orange brown sandy CLAY. Sand is fine to medium. Gravel is fine to coarse, angular to subrounded flint and with occasional chalk cobbles
		0.80	D					
		1.00		N=14 (2,2/2,4,4,4)				
					1.60	34.32		Orange brown slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse with occasional rare cobbles of angular to subangular flint.
		1.70	D					
		2.00		N=15 (3,2/3,4,4,4)	2.00	33.92		Off white CHALK. Recovered as silty gravel. Gravel is fine to medium occasionally cobble sized chalk.
		2.80	D					
		3.00		N=4 (1,1/1,1,1,1)				
		4.00		N=3 (1,2/1,0,1,1)	4.00	31.92		End of borehole at 4.00 m

Remarks
Borehole remained stable. Groundwater seepage at 3.0m rising to 1.1m upon completion. Borehole was backfilled with arisings to 3.0m .Install comprised 1.0m plain pipe with bentonite surround over 2.0m slotted pipe with gravel surround. SPT hammer ratio 76.66%.

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Borehole Log

Borehole No.
WS106
Sheet 1 of 1

Project Name: Twyford Bridge Farm	Project No. LP3302	Co-ords: 478298 - 176598	Hole Type WS
Location: Twyford Bridge Farm, Reading, RG10 9PP		Level: 35.39	Scale 1:20
Client: Croudace Homes Ltd (Caterham)		Dates: 12/04/2023 - 12/04/2023	Logged By IA

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES					Grass over TOPSOIL: Dark brown sandy silty gravelly silt. Sand is fine. Gravel is fine to coarse angular to subrounded flint, brick and occasional rare tile fragments.
					0.25	35.14		Firm to stff reddish brown sandy silty gravelly CLAY. Sand is fine to medium. Gravel is fine to coarse angular to subrounded flint.
		1.00		N=9 (2,2/2,3,2,2)	1.00	34.39		Firm to stiff range brown sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to coarse subangular to subrounded flint and chalk
		1.50	D					
		2.00		N=26 (2,3/5,6,7,8)	2.00	33.39		Off white CHALK. Recovered as silty gravel. Gravel is fine to medium angular to subrounded chalk and occasional flint.
		2.80	D					
		3.00		N=4 (1,2/1,1,0,2)				
		4.00		N=2 (1,2/0,1,0,1)	4.00	31.39		End of borehole at 4.00 m

Remarks
Borehole remained dry and stable. Borehole was backfilled with arisings to 3.0m. Install comprised 1.0m plain pipe with bentonite surround over 2.0m slotted pipe with gravel surround. SPT hammer ratio 76.66%.

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APPENDIX F – Groundwater and Ground Gas Monitoring Records

Groundwater and Ground Gas Monitoring Records

Continuous Gas Monitoring Record

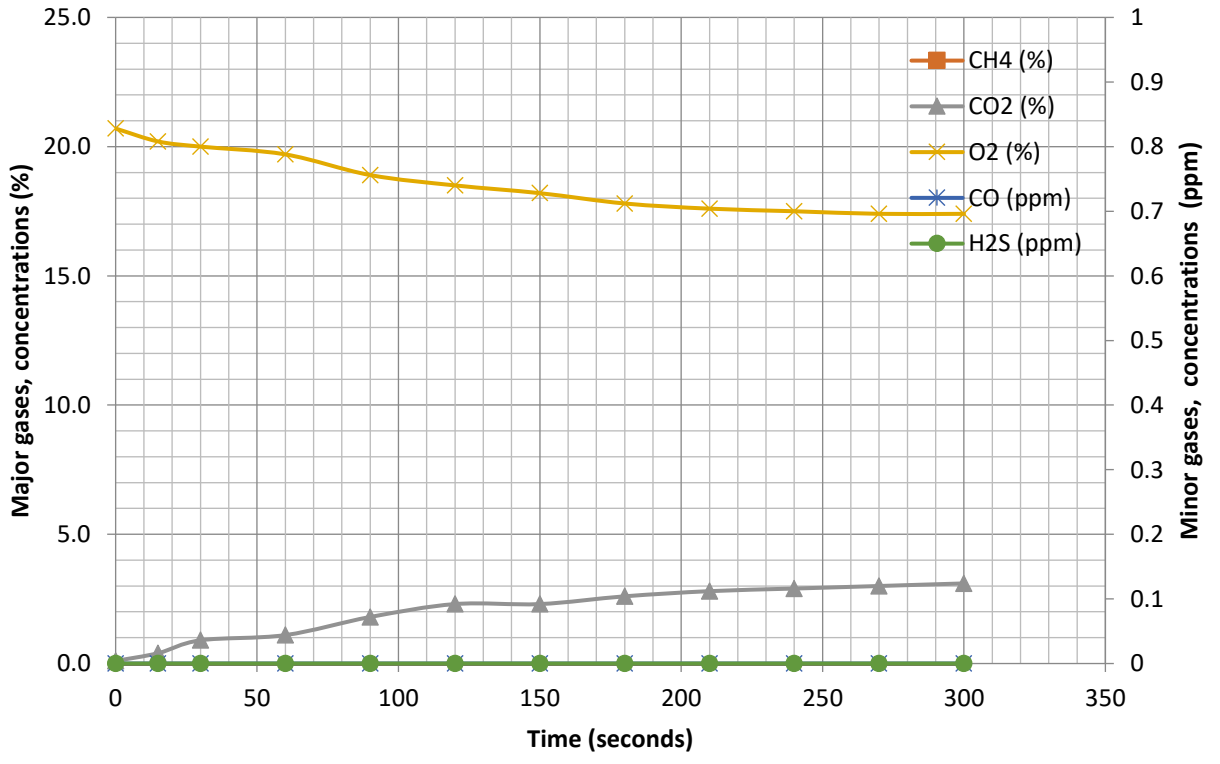
Date	04/05/2023	Engineer	HK
Project No	LP3302	Temp °C	16
Site	Twyford Bridge	Ambient Pressure	1009

WS101

Hole ID

VOC peak (ppm)	0.3
VOC steady (ppm)	0.3
Borehole Depth (mbgl)	2.6
Water level (mbgl)	Dry
Borehole Pressure (Pa)	0

Time	Flow (ʃ/h)	CH^4 (%)	CO^2 (%)	O^2 (%)	CO (ppm)	H^2S (ppm)
00:00	0.0	-0.1	0.1	20.7	0	0
00:15	0.0	-0.1	0.4	20.2	0	0
00:30	0.0	-0.1	0.9	20.0	0	0
01:00	0.0	-0.1	1.1	19.7	0	0
01:30	0.0	-0.1	1.8	18.9	0	0
02:00	0.0	-0.1	2.3	18.5	0	0
02:30	0.0	-0.1	2.3	18.2	0	0
03:00	0.0	-0.1	2.6	17.8	0	0
03:30	0.0	-0.1	2.8	17.6	0	0
04:00	0.0	-0.1	2.9	17.5	0	0
04:30	0.0	-0.1	3.0	17.4	0	0
05:00	0.0	-0.1	3.1	17.4	0	0



Continuous Gas Monitoring Record

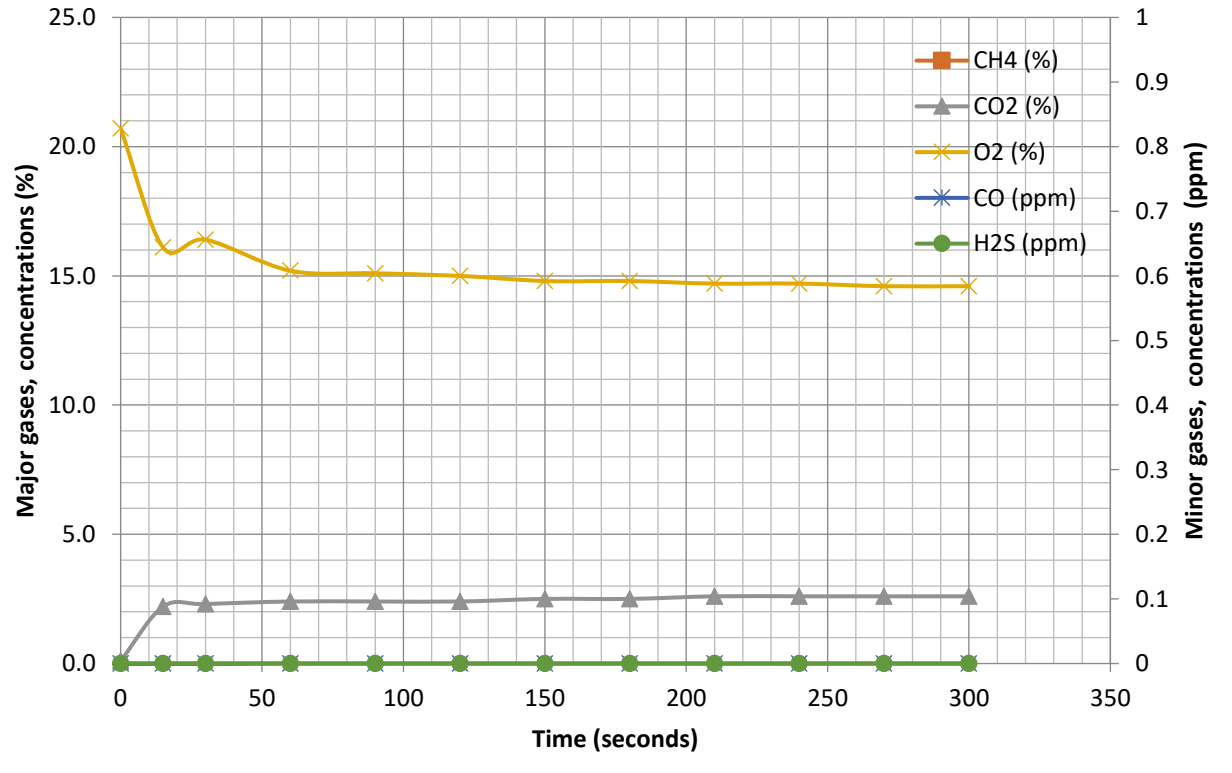
Date	04/05/2023	Engineer	HK
Project No	LP3302	Temp °C	14
Site	Twyford Bridge	Ambient Pressure	1010

WS103

Hole ID

VOC peak (ppm)	1.1
VOC steady (ppm)	0.9
Borehole Depth (mbgl)	3.21
Water level (mbgl)	Dry
Borehole Pressure (Pa)	0

Time	Flow (ʃ/h)	CH^4 (%)	CO^2 (%)	O^2 (%)	CO (ppm)	H^2S (ppm)
00:00	0.0	-0.1	0.1	20.7	0	0
00:15	0.0	-0.1	2.2	16.1	0	0
00:30	0.0	-0.1	2.3	16.4	0	0
01:00	0.0	-0.2	2.4	15.2	0	0
01:30	0.0	-0.2	2.4	15.1	0	0
02:00	0.0	-0.2	2.4	15.0	0	0
02:30	0.0	-0.2	2.5	14.8	0	0
03:00	0.0	-0.2	2.5	14.8	0	0
03:30	0.0	-0.2	2.6	14.7	0	0
04:00	0.0	-0.2	2.6	14.7	0	0
04:30	0.0	-0.2	2.6	14.6	0	0
05:00	0.0	-0.2	2.6	14.6	0	0



Continuous Gas Monitoring Record

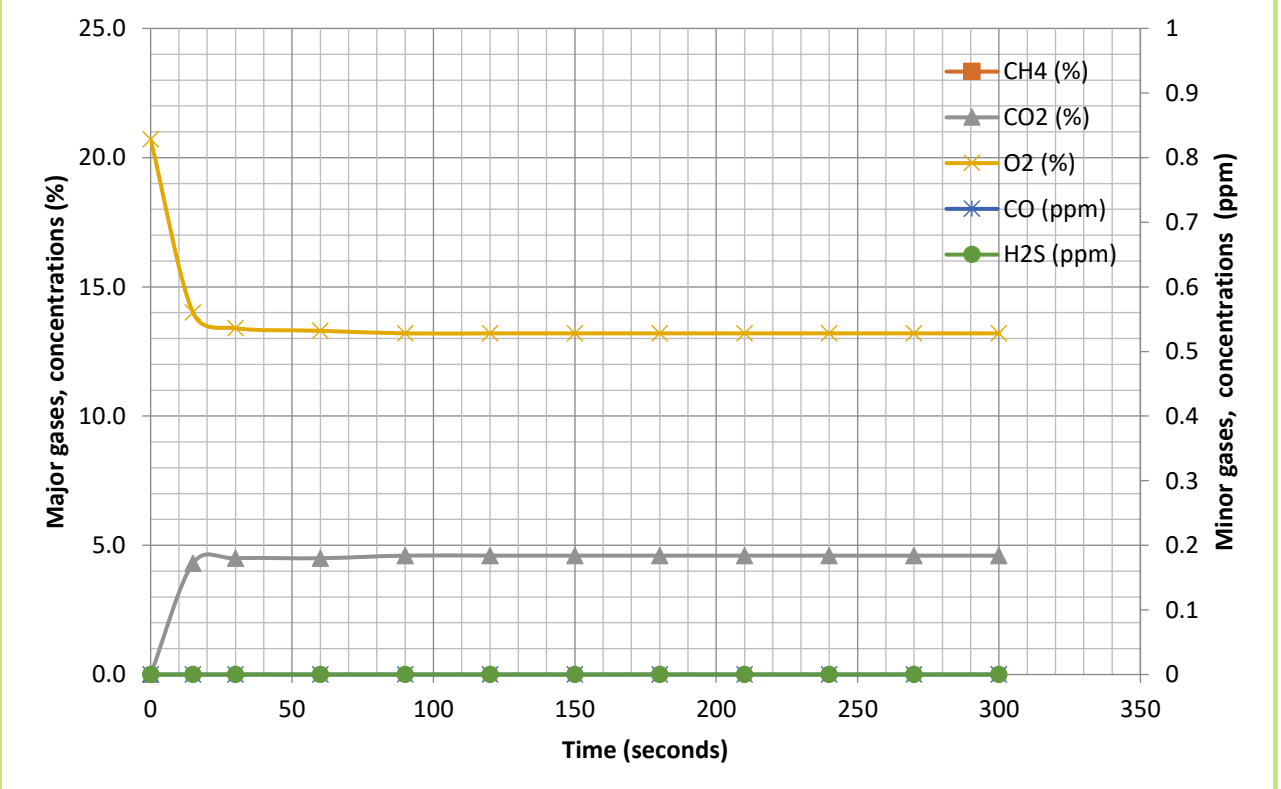
Date	04/05/2023	Engineer	HK
Project No	LP3302	Temp °C	14
Site	Twyford Bridge	Ambient Pressure	1010

WS105

Hole ID

VOC peak (ppm)	1.5
VOC steady (ppm)	1.5
Borehole Depth (mbgl)	2.96
Water level (mbgl)	1.94
Borehole Pressure (Pa)	0

Time	Flow (ʃ/h)	CH^4 (%)	CO^2 (%)	O^2 (%)	CO (ppm)	H^2S (ppm)
00:00	0.0	-0.2	0.0	20.7	0	0
00:15	0.0	-0.2	4.3	14.0	0	0
00:30	0.0	-0.2	4.5	13.4	0	0
01:00	0.0	-0.2	4.5	13.3	0	0
01:30	0.0	-0.2	4.6	13.2	0	0
02:00	0.0	-0.2	4.6	13.2	0	0
02:30	0.0	-0.2	4.6	13.2	0	0
03:00	0.0	-0.2	4.6	13.2	0	0
03:30	0.0	-0.2	4.6	13.2	0	0
04:00	0.0	-0.2	4.6	13.2	0	0
04:30	0.0	-0.2	4.6	13.2	0	0
05:00	0.0	-0.2	4.6	13.2	0	0



Continuous Gas Monitoring Record

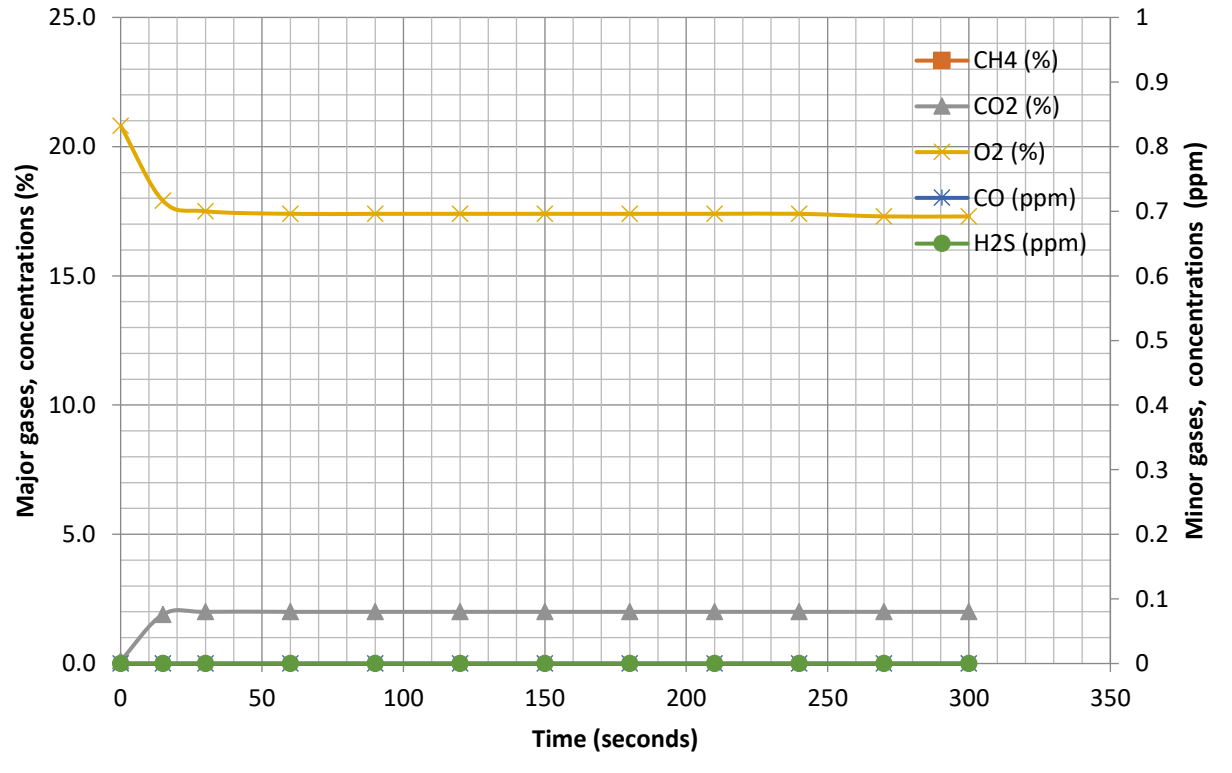
Date	04/05/2023	Engineer	HK
Project No	LP3302	Temp °C	16
Site	Twyford Bridge	Ambient Pressure	1006

WS106

Hole ID

VOC peak (ppm)	1.5
VOC steady (ppm)	1.5
Borehole Depth (mbgl)	2.96
Water level (mbgl)	1.94
Borehole Pressure (Pa)	0

Time	Flow (ʃ/h)	CH^4 (%)	CO^2 (%)	O^2 (%)	CO (ppm)	H^2S (ppm)
00:00	0.0	-0.1	0.1	20.8	0	0
00:15	0.0	-0.1	1.9	17.9	0	0
00:30	0.0	-0.1	2.0	17.5	0	0
01:00	0.0	-0.1	2.0	17.4	0	0
01:30	0.0	-0.1	2.0	17.4	0	0
02:00	0.0	-0.1	2.0	17.4	0	0
02:30	0.0	-0.1	2.0	17.4	0	0
03:00	0.0	-0.1	2.0	17.4	0	0
03:30	0.0	-0.1	2.0	17.4	0	0
04:00	0.0	-0.1	2.0	17.4	0	0
04:30	0.0	-0.1	2.0	17.3	0	0
05:00	0.0	-0.1	2.0	17.3	0	0



Continuous Gas Monitoring Record

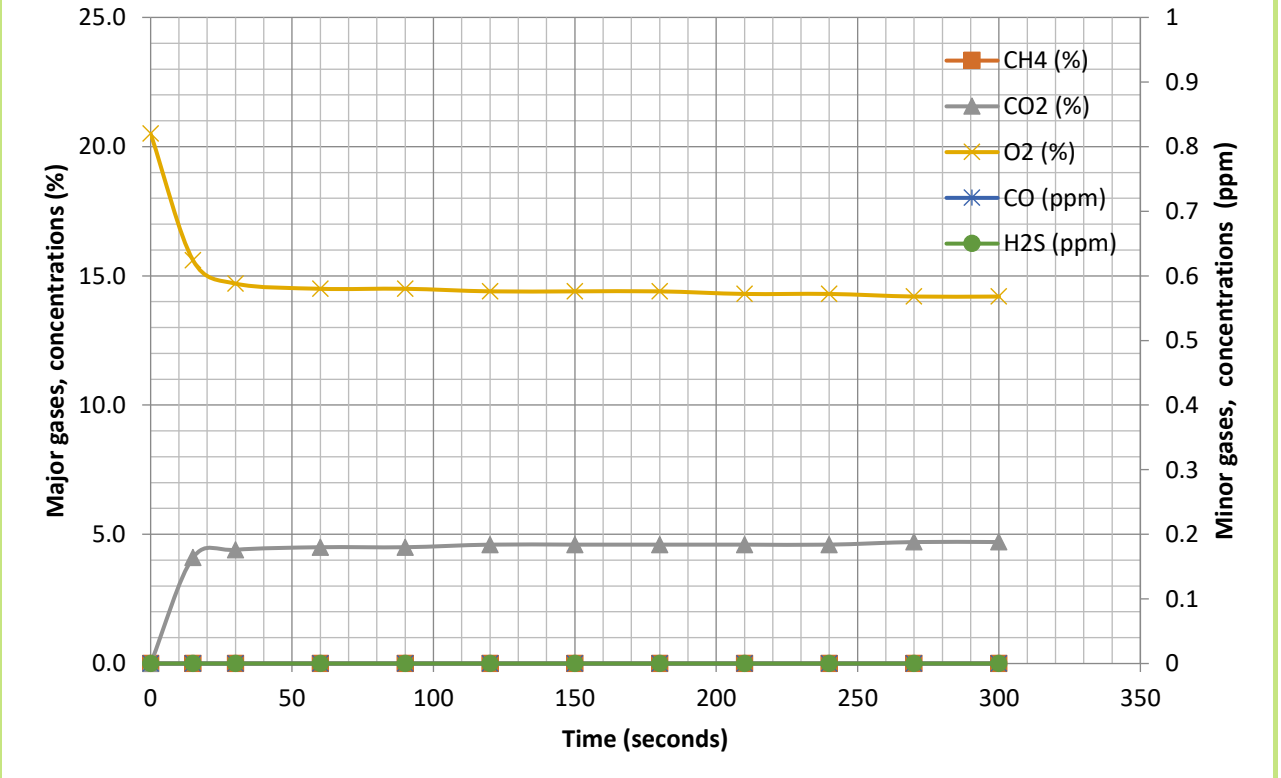
Date	18/04/2023	Engineer	HK
Project No	LP3302	Temp °C	12
Site	Twyford Bridge	Ambient Pressure	1021

WS101

Hole ID

VOC peak (ppm)	0.1
VOC steady (ppm)	0.1
Borehole Depth (mbgl)	2.59
Water level (mbgl)	Dry
Borehole Pressure (Pa)	0

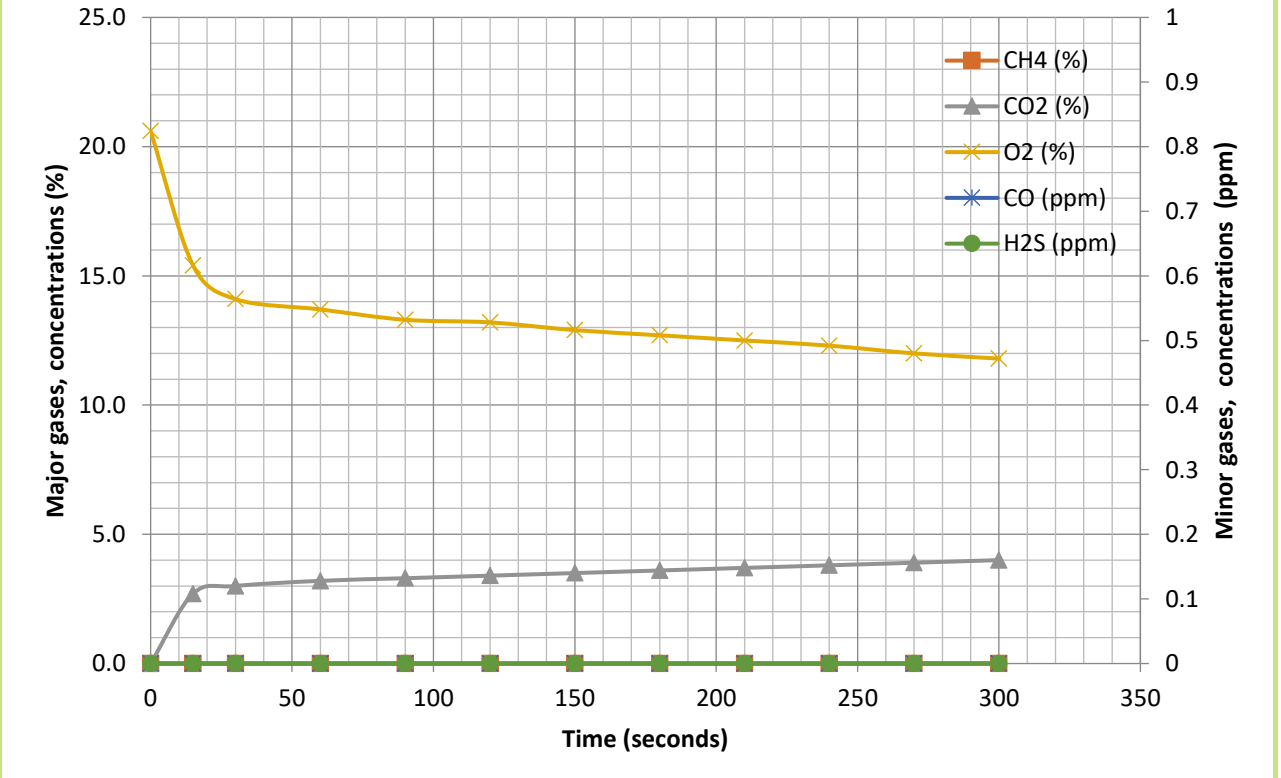
Time	Flow (ʃ/h)	CH^4 (%)	CO^2 (%)	O^2 (%)	CO (ppm)	H^2S (ppm)
00:00	0.0	0.0	0.0	20.5	0	0
00:15	0.0	0.0	4.1	15.6	0	0
00:30	0.0	0.0	4.4	14.7	0	0
01:00	0.0	0.0	4.5	14.5	0	0
01:30	0.0	0.0	4.5	14.5	0	0
02:00	0.0	0.0	4.6	14.4	0	0
02:30	0.0	0.0	4.6	14.4	0	0
03:00	0.0	0.0	4.6	14.4	0	0
03:30	0.0	0.0	4.6	14.3	0	0
04:00	0.0	0.0	4.6	14.3	0	0
04:30	0.0	0.0	4.7	14.2	0	0
05:00	0.0	0.0	4.7	14.2	0	0



Continuous Gas Monitoring Record

Date	18/04/2023	Engineer	HK
Project No	LP3302	Temp °C	12
Site	Twyford Bridge	Ambient Pressure	1021

		Time	Flow (ʃ/h)	CH^4 (%)	CO^2 (%)	O^2 (%)	CO (ppm)	H^2S (ppm)
WS103		00:00	0.0	0.0	0.0	20.6	0	0
Hole ID		00:15	0.0	0.0	2.7	15.4	0	0
VOC peak (ppm)	0.1	00:30	0.0	0.0	3.0	14.1	0	0
		01:00	0.0	0.0	3.2	13.7	0	0
VOC steady (ppm)	0	01:30	0.0	0.0	3.3	13.3	0	0
		02:00	0.0	0.0	3.4	13.2	0	0
Borehole Depth (mbgl)	3.2	02:30	0.0	0.0	3.5	12.9	0	0
		03:00	0.0	0.0	3.6	12.7	0	0
Water level (mbgl)	Dry	03:30	0.0	0.0	3.7	12.5	0	0
		04:00	0.0	0.0	3.8	12.3	0	0
Borehole Pressure (Pa)	0	04:30	0.0	0.0	3.9	12.0	0	0
		05:00	0.0	0.0	4.0	11.8	0	0



Continuous Gas Monitoring Record

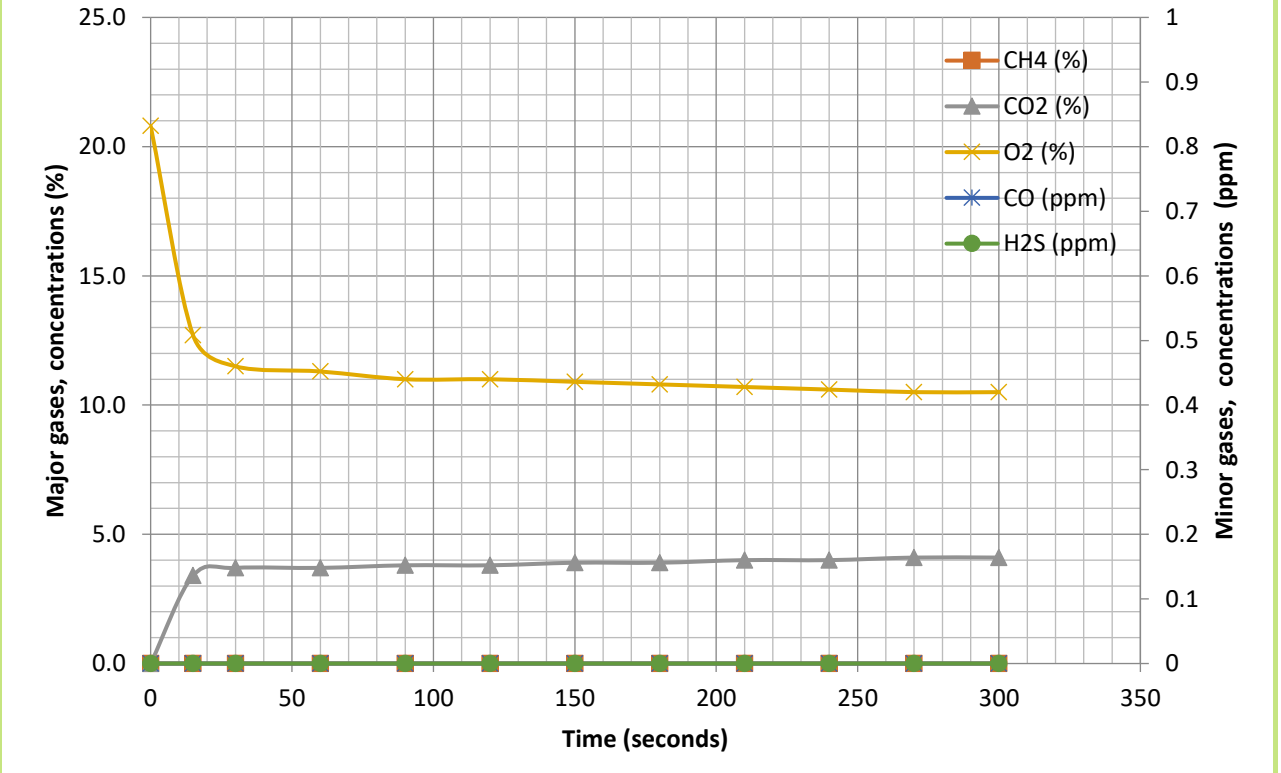
Date	18/04/2023	Engineer	HK
Project No	LP3302	Temp °C	13
Site	Twyford Bridge	Ambient Pressure	1022

WS105

Hole ID

VOC peak (ppm)	0.2
VOC steady (ppm)	0.1
Borehole Depth (mbgl)	2.06
Water level (mbgl)	1.78
Borehole Pressure (Pa)	0

Time	Flow (ʃ/h)	CH^4 (%)	CO^2 (%)	O^2 (%)	CO (ppm)	H^2S (ppm)
00:00	0.0	0.0	0.0	20.8	0	0
00:15	0.0	0.0	3.4	12.7	0	0
00:30	0.0	0.0	3.7	11.5	0	0
01:00	0.0	0.0	3.7	11.3	0	0
01:30	0.0	0.0	3.8	11.0	0	0
02:00	0.0	0.0	3.8	11.0	0	0
02:30	0.0	0.0	3.9	10.9	0	0
03:00	0.0	0.0	3.9	10.8	0	0
03:30	0.0	0.0	4.0	10.7	0	0
04:00	0.0	0.0	4.0	10.6	0	0
04:30	0.0	0.0	4.1	10.5	0	0
05:00	0.0	0.0	4.1	10.5	0	0



Continuous Gas Monitoring Record

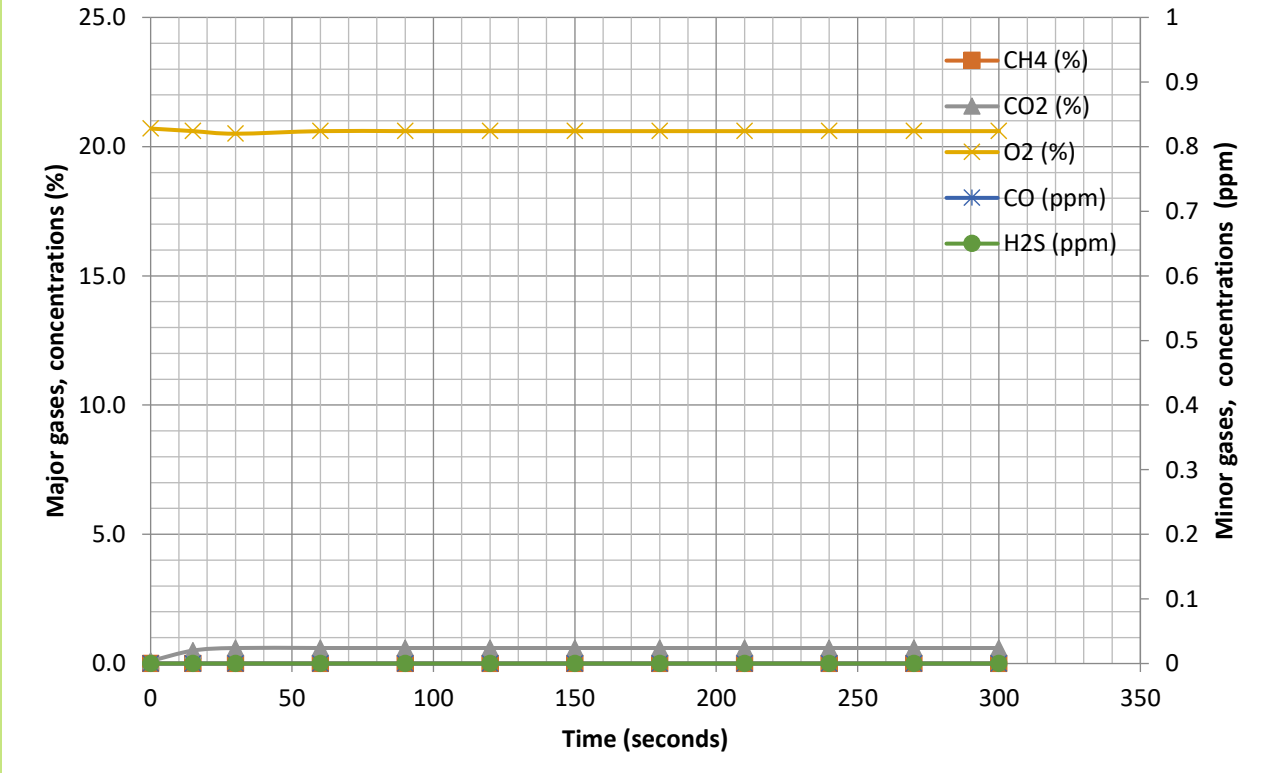
Date	18/04/2023	Engineer	HK
Project No	LP3302	Temp °C	12
Site	Twyford Bridge	Ambient Pressure	1021

WS106

Hole ID

VOC peak (ppm)	0.1
VOC steady (ppm)	0
Borehole Depth (mbgl)	3.16
Water level (mbgl)	1.28
Borehole Pressure (Pa)	22

Time	Flow (ʃ/h)	CH^4 (%)	CO^2 (%)	O^2 (%)	CO (ppm)	H^2S (ppm)
00:00	4.5	0.0	0.1	20.7	0	0
00:15	3.0	0.0	0.5	20.6	0	0
00:30	1.0	0.0	0.6	20.5	0	0
01:00	0.1	0.0	0.6	20.6	0	0
01:30	0.0	0.0	0.6	20.6	0	0
02:00	0.0	0.0	0.6	20.6	0	0
02:30	0.0	0.0	0.6	20.6	0	0
03:00	0.0	0.0	0.6	20.6	0	0
03:30	0.0	0.0	0.6	20.6	0	0
04:00	0.0	0.0	0.6	20.6	0	0
04:30	0.0	0.0	0.6	20.6	0	0
05:00	0.0	0.0	0.6	20.6	0	0



LP3302 Twyford Bridge Farm

Test Location	Visit 1 (18/04/2023)		Visit 2 (24/04/2023)		Visit 3 (04/05/2023)	
	Depth to base (m)	Depth to water (m)	Depth to base (m)	Depth to water (m)	Depth to base (m)	Depth to water (m)
WS105	2.06	1.78	3.00	1.86	2.96	1.94
WS103	3.20	Dry	3.21	Dry	3.21	Dry
WS101	2.59	Dry	2.59	Dry	2.60	Dry
WS106	3.16	1.28	3.14	1.41	3.12	1.49

APPENDIX G – Geotechnical Laboratory Test Results

Geotechnical Laboratory Test Results

GEOLABS Limited
Bucknalls Lane
Garston
Watford
Hertfordshire
WD25 9XX
Tel: +44(0) 1923 892 190
Fax: +44(0) 1923 892 191
email: admin@geolabs.co.uk
web: www.geolabs.co.uk

Leap Environmental Limited
Southern Coast Regional Office
Victoria Road
Burgess Hill
West Sussex
RH15 9LR

05 May 2023
Report No : GEO/37862/01

For the attention of Mr A Carr

Date samples received	19/04/2023
Date written instructions received	18/04/2023
Date testing commenced	20/04/2023
Date of sample disposal	**02/06/2023**

Our ref **GEO / 37862**
Your Ref **LP3302**

Project **TWYFORD BRIDGE**

Further to your instructions we have pleasure in enclosing the results of the tests you requested in the attached figures.

LABORATORY TEST REPORT

Item No	Test Quantity	Description
1	~	Geotechnical Test Summary
~	2	Water Content
~	2	Liquid & Plastic Limits
2	3	Saturation Moisture Content
3	~	Geochemical Test Summary
~	2	BRE SD1 Suite A - Natural ground
~	2	BRE SD1 Suite B - Natural ground + pyrite
4	4	Particle Size Distribution

Any opinions or interpretations expressed herein are outside the scope of UKAS accreditation. All results contained in this report are provisional unless signed by an approved signatory. The results contained in this report relate only to samples received in the laboratory and are tested 'as received' unless otherwise stated. This report should not be reproduced, except in full, without the written approval of the laboratory. The results reported are applicable only to the test items received by the laboratory.

All the necessary data required by the documented test procedures has been recorded and will be stored for a period of not less than 6 years. This data will be issued to yourselves at your request. All samples will be disposed of after the date shown above. Written confirmation will be required to retain the samples beyond this period and a storage charge may be applied.

We trust that the above meets your requirements and should you require any further information or assistance, please do not hesitate to contact us.

Yours faithfully

[redacted]

Senior Technician

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Location	Depth (m)	Sample Ref	Type	Description	WC %	LL %	PL %	PI %	<425 µm %	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 g/L	W/S Mg mg/L	
TP101	1.10		B	Brown silty clayey SAND and GRAVEL.															Particle Size Distribution
TP102	1.20		B	Orangish brown silty clayey SAND.															Particle Size Distribution
TP103	0.80		D	Orangish brown mottled dark brown slightly gravelly sandy CLAY. Sand and gravel are fine.	14.9	31	14	17	97										
TP105	2.60		D																Chemical
TP108	1.20		B																Chemical
TP109	1.10		B	Brown slightly clayey very sandy GRAVEL with one cobble.															Particle Size Distribution
TP110	0.80		D																Chemical
TP113	1.50		B	Light brown silty clayey very sandy GRAVEL.															Particle Size Distribution
WS102	1.80		D																Chemical
WS105	0.80		D	Yellowish brown and brown sandy gravelly CLAY. Sand is fine.	13.1	24	13	11	75										Chemical

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

[redacted]

Project Number:

GEO / 37862

Project Name:

TWYFORD BRIDGE
LP3302

GEOLABS®

BS 1377-2 : 2022 : 4.2

SATURATION WATER CONTENT OF CHALK

Location	Depth m	Sample Ref	Sample Type	Description	Water Content BS EN ISO 17892-1 : 2014 %	Bulk Density BS EN ISO 17892-2 : 2014 : 5.2 Mg/m³	Dry Density BS EN ISO 17892-2 : 2014 : 5.2 Mg/m³	Saturation Water Content %	Porosity %
TP110	2.30		B	White CHALK.	26.7	1.99	1.57	27	42
TP112	1.70		D	White CHALK	31.3	1.93	1.47	31	46
TP114	2.50		B	White CHALK	27.7	1.97	1.54	28	43

Notes

[redacted]

Project Number:

GEO / 37862

Project Name:

TWYFORD BRIDGE

LP3302

GEOLABS®

1240 - Chemical Test Summary - 37862.XLSM

SUMMARY OF CHEMICAL TESTS ON SOIL

Location	Depth m	Sample Ref	Sample Type	pH Value	Total Acid Soluble Sulphate as SO4 %	Water Soluble Sulphate as SO4 2:1 Water:Soil Extract g/l	Total Sulphur %	Water Soluble Chloride g/l	Water Soluble Nitrate g/l	Magnesium g/l	Organic Content %	Mass Loss on Ignition %	Carbonate Content %
TP105	2.60		D	7.6	0.013	< 0.010	0.020	-	-	-	-	-	-
TP108	1.20		B	7.8	-	< 0.010	-	-	-	-	-	-	-
TP110	0.80		D	7.4	0.015	< 0.010	0.016	-	-	-	-	-	-
WS102	1.80		D	7.9	-	< 0.010	-	-	-	-	-	-	-
WS105	0.80		D	8.5	0.030	< 0.010	0.010	-	-	-	-	-	-

Tested by Chemtest Ltd : MCERTS / UKAS No 2183

[redacted]:

Project Number:

GEO / 37862

Project Name:

TWYFORD BRIDGE

LP3302

GEOLABS®

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

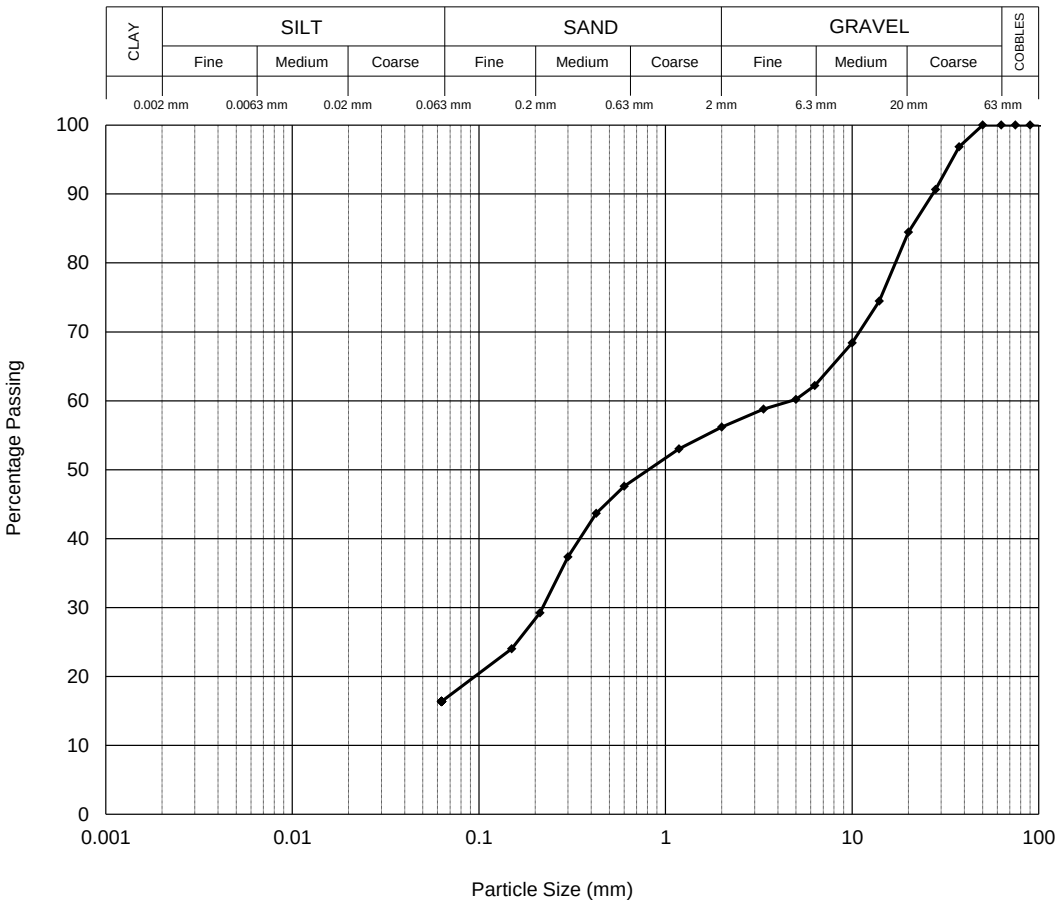
Location	TP101
Depth (m)	1.10
Sample Type	B

Description

Brown silty clayey SAND and GRAVEL.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	97
28.0 mm	91
20.0 mm	84
14.0 mm	74
10.0 mm	68
6.30 mm	62
5.00 mm	60
3.35 mm	59
2.00 mm	56
1.18 mm	53
600 µm	48
425 µm	44
300 µm	37
212 µm	29
150 µm	24
63 µm	16



Particle Proportions	
Cobbles	0.0
Gravel	43.8
Sand	39.8
Silt & Clay	16.4

Tested by AW

[redacted]

Project Number:

GEO / 37862

Project Name:

TWYFORD BRIDGE
LP3302

GEOLABS ® UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

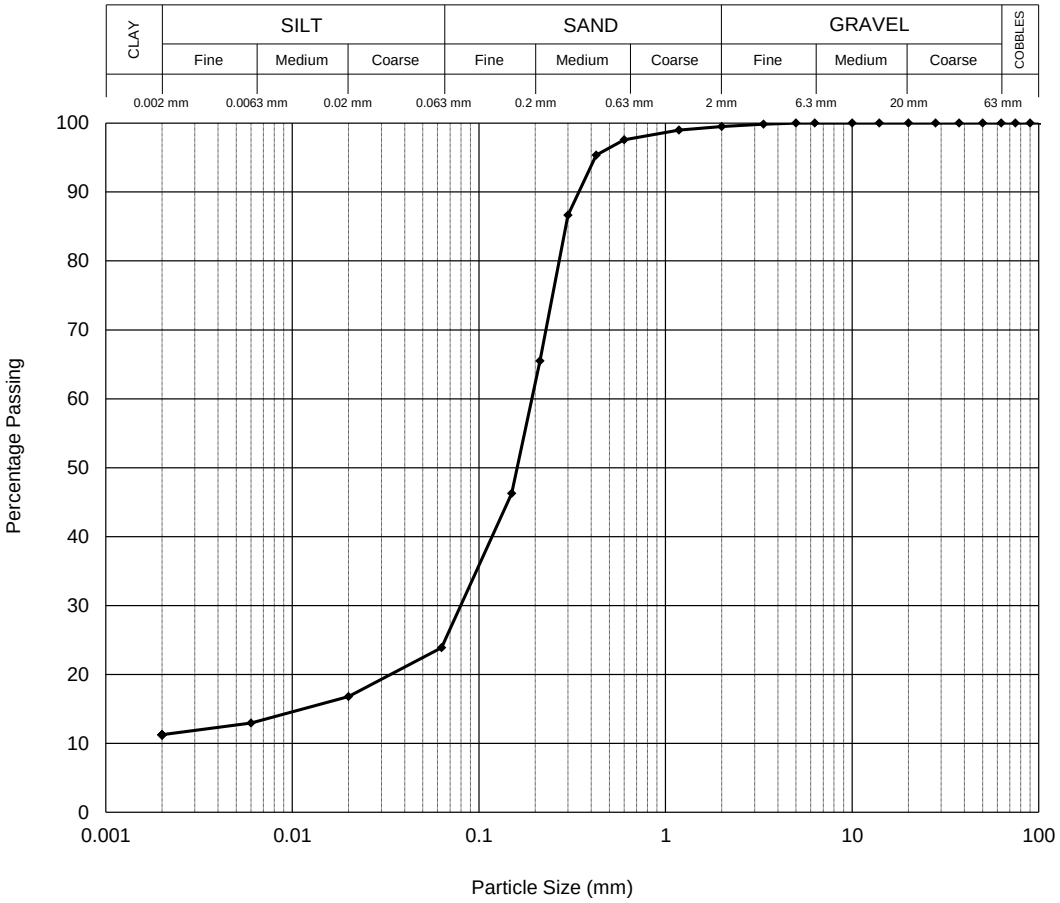
Location	TP102
Depth (m)	1.20
Sample Type	B

Description

Orangish brown silty clayey SAND.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve
BS EN ISO 17892-4 : 2016 : Clause 5.4 - Sedimentation by Pipette

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
10.0 mm	100
6.30 mm	100
5.00 mm	100
3.35 mm	100
2.00 mm	100
1.18 mm	99
600 µm	98
425 µm	95
300 µm	87
212 µm	66
150 µm	46
63 µm	24



Sedimentation	
No Pre-treatment used	
Temp (°C)	25.0
Size	% Pass
20 µm	17
6 µm	13
2 µm	11

Particle Density 2.70(A) Mg/m³

Particle Proportions	
Cobbles	0.0
Gravel	0.5
Sand	75.6
Silt	12.6
Clay	11.3

Project Number:

GEO / 37862

Project Name:

TWYFORD BRIDGE
LP3302

GEOLABS ® UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

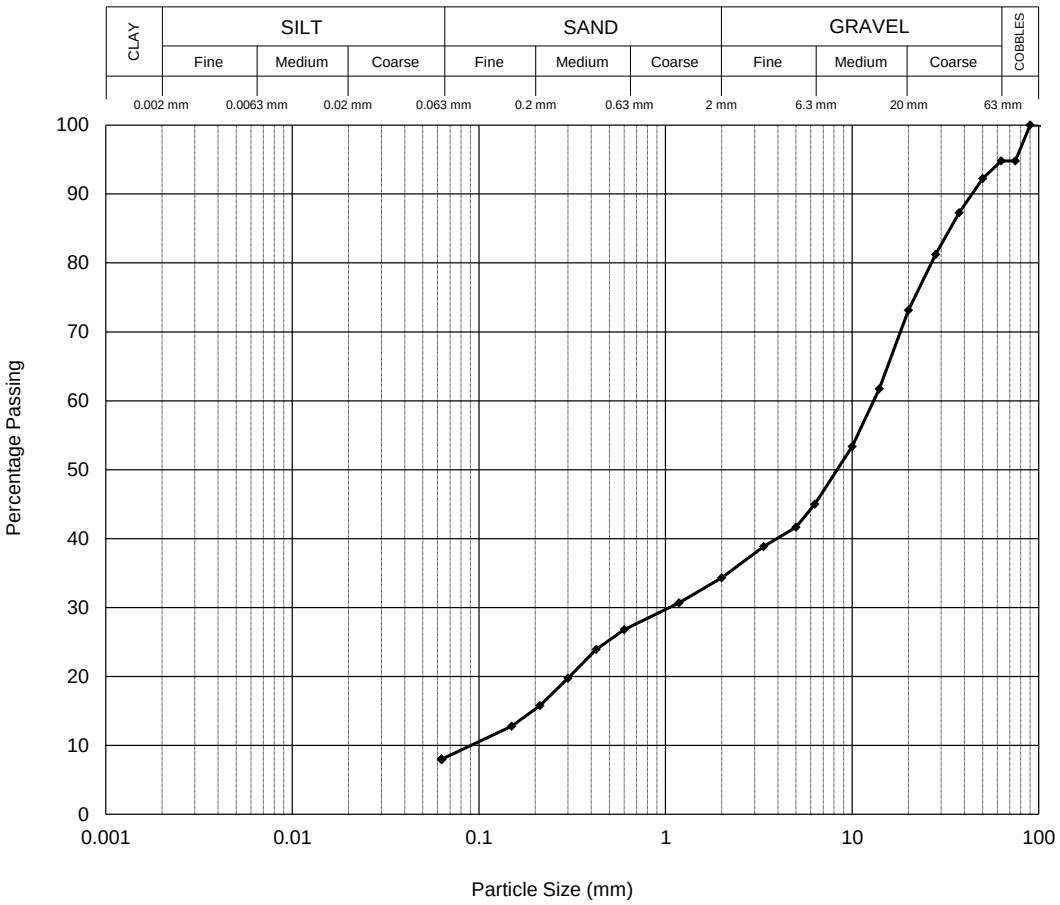
Location	TP109
Depth (m)	1.10
Sample Type	B

Description

Brown slightly clayey very sandy GRAVEL with one cobble.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	95
63.0 mm	95
50.0 mm	92
37.5 mm	87
28.0 mm	81
20.0 mm	73
14.0 mm	62
10.0 mm	53
6.30 mm	45
5.00 mm	42
3.35 mm	39
2.00 mm	34
1.18 mm	31
600 µm	27
425 µm	24
300 µm	20
212 µm	16
150 µm	13
63 µm	8



Particle Proportions	
Cobbles	5.2
Gravel	60.5
Sand	26.3
Silt & Clay	8.0

Project Number:

GEO / 37862

Project Name:

TWYFORD BRIDGE
LP3302

GEOLABS ® UKAS TESTING 1982

Test Report By GEOLABS Limited Bucknalls Lane, Garston, Watford, Hertfordshire, WD25 9XX

Client : Leap Environmental Limited, Southern Coast Regional Office, Victoria Road, Burgess Hill, West Sussex, RH15 9LR (Ref 1683298174)

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

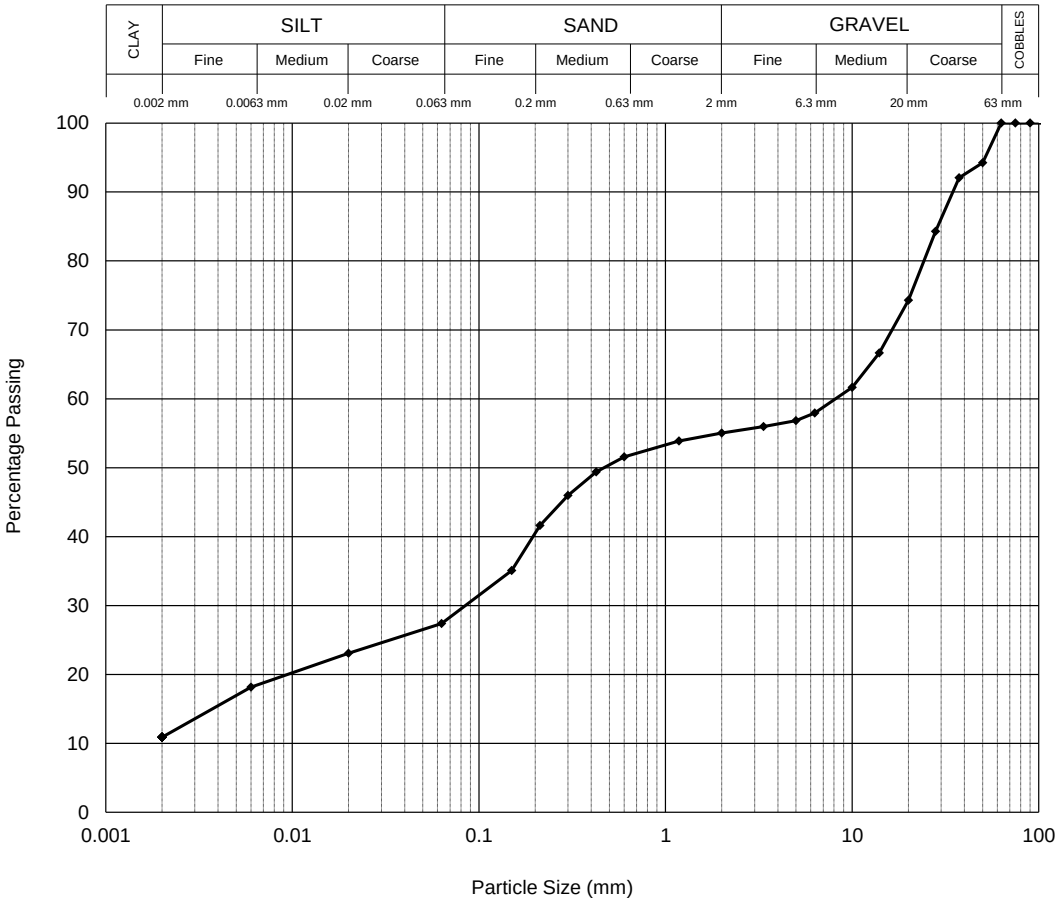
Location	TP113
Depth (m)	1.50
Sample Type	B

Description

Light brown silty clayey very sandy GRAVEL.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve
BS EN ISO 17892-4 : 2016 : Clause 5.4 - Sedimentation by Pipette

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	94
37.5 mm	92
28.0 mm	84
20.0 mm	74
14.0 mm	67
10.0 mm	62
6.30 mm	58
5.00 mm	57
3.35 mm	56
2.00 mm	55
1.18 mm	54
600 µm	52
425 µm	49
300 µm	46
212 µm	42
150 µm	35
63 µm	27



Sedimentation	
No Pre-treatment used	
Temp (°C)	25.0
Size	% Pass
20 µm	23
6 µm	18
2 µm	11
Particle Density 2.70(A) Mg/m³	

Particle Proportions	
Cobbles	0.0
Gravel	45.0
Sand	27.6
Silt	16.5
Clay	10.9

Project Number:

GEO / 37862

Project Name:

TWYFORD BRIDGE
LP3302

GEOLABS ® UKAS TESTING 1982

GEOLABS®

Client	Leap Environmental Limited
Project No.	37862
Project Name	TWYFORD BRIDGE

TEST RESTRICTION

The following tests have been scheduled on the above project and **CANNOT** be performed for the reason stated. If alternative samples are available for the restricted tests, please supply details.

Laboratory ID	BH / TP No.	Sample Ref.	Depth (m)		Type	Test(s) Scheduled			Reason for Restriction	Description
483770	TP110		2.30		D	SMC			No suitable sized chalk gravel present in the sample - all too small to test for SMC.	White structureless CHALK.
483768	WS101		3.50		D	SMC			No suitable sized chalk gravel present in the sample - all too small to test for SMC.	White structureless CHALK.
483772	WS105		2.80		D	SMC			No suitable sized chalk gravel present in the sample - all too small to test for SMC.	White structureless CHALK.

Comments / remarks		Test restriction raised by SB

APPENDIX H – Analytical Summary and Quantitative Risk Assessment Tables

Analytical Summary and Quantitative Risk Assessment Tables

LP3254 Twyford Bridge Farm
Soil Analytical Results and Human Health QRA

Determinand	Units	Assessment Criteria Value*	Criteria Source	Maximum Detected	Sample Location:	TP101	TP102	TP105	TP106	TP108	TP109	TP111	TP113	TP115	TP116	WS106	WS103	TP111
					Depth (m):	0.10	0.40	0.10	2.10	0.20	0.15	0.10	0.15	0.50	0.15	0.10	0.10	0.55
					Matrix:	TS	SS	TS	MDGD	TS	TS	MDGD	TS	SS	TS	TS	TS	MDGD
					Date Sampled:	12-Apr-23	12-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23	11-Apr-23
Miscellaneous																		
pH	pH units	n.a.	-	8.05	6.64	7.52	5.91	7.85	6.02	6.41	7.57	7.02	5.68	6.75	7.78	-	-	8.05
Total Organic Carbon	%	n.a.	-	2.21	1.51	0.28	1.35	1.21	1.09	1.96	2.21	1	0.54	1.88	2.2	-	-	1.38
Soil Organic Matter (calculated)**	%	n.a.	-	3.80	2.60	0.48	2.08	2.08	1.87	3.34	3.80	1.72	0.58	3.23	3.78	-	-	2.37
				0														
Metals																		
Arsenic	mg/kg	37	C4SL	12	4	5	5	12	4	4	6	6	2	4	5	-	<1	
Cadmium	mg/kg	22	C4SL	1.1	<0.1	<0.2	<0.2	1.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	
Chromium	mg/kg	910	S4UL	31	11	16	10	16	10	11	12	18	16	15	14	-	31	
Chromium VI	mg/kg	21	C4SL	0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	<1	
Copper	mg/kg	2,400	S4UL	244	13	7	9	244	10	11	17	8	8	11	20	-	12	
Lead	mg/kg	200	C4SL	305	22	11	20	305	17	18	61	10	7	22	17	-	33	
Mercury	mg/kg	40	S4UL	4.53	0.32	<0.17	<0.17	4.53	<0.17	<0.17	0.59	<0.17	<0.17	<0.17	<0.17	-	4.15	
Nickel	mg/kg	130	S4UL	23	9	13	7	23	7	8	10	15	14	9	13	-	21	
Selenium	mg/kg	250	S4UL	2	<1	<1	<1	<1	<1	<1	<1	2	<1	<1	<1	-	<1	
Zinc	mg/kg	3,700	S4UL	6790	46	34	37	6790	40	47	65	39	44	48	73	-	77	
Asbestos																		
Asbestos Identification	-	Presence	-	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	-	NAD	
Polycyclic Aromatic Hydrocarbons (USEPA 16)																		
Acenaphthene	mg/kg	5.0	C4SL	0.45	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.37	<0.01	<0.01	<0.01	<0.01	-	0.45	
Naphthalene	mg/kg	2.3	S4UL	0.35	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.35	<0.01	<0.01	<0.01	<0.01	-	0.14	
Acenaphthylene	mg/kg	n.a.	-	1.87	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	1.87	<0.02	<0.02	<0.02	<0.02	-	1.71	
Acenaphthene	mg/kg	n.a.	-	16.4	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	16.4	<0.04	<0.04	<0.04	<0.04	-	11.4	
Fluorene	mg/kg	n.a.	-	18.4	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	18.4	0.05	<0.04	<0.04	<0.04	-	12.2	
Phenanthrene	mg/kg	n.a.	-	23.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	23.2	0.06	<0.05	<0.05	<0.05	-	15.6	
Anthracene	mg/kg	n.a.	-	11.6	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	11.6	<0.05	<0.05	<0.05	<0.05	-	7.82	
Fluoranthene	mg/kg	n.a.	-	8.13	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	8.13	<0.07	<0.07	<0.07	<0.07	-	5.87	
Pyrene	mg/kg	n.a.	-	17.4	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	17.4	<0.06	<0.06	<0.06	<0.06	-	10.8	
Benzo(a)anthracene	mg/kg	n.a.	-	3.61	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	3.61	<0.04	<0.04	<0.04	<0.04	-	2.19	
Chrysene	mg/kg	n.a.	-	19.4	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	19.4	<0.08	<0.08	<0.08	<0.08	-	17.8	
Benzo(b)fluoranthene	mg/kg	n.a.	-	0.43	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.32	<0.01	<0.01	<0.01	<0.01	-	0.43	
Benzo(k)fluoranthene	mg/kg	n.a.	-	15.2	0.03	<0.01	0.03	<0.01	<0.01	<0.01	15.2	0.04	<0.01	<0.01	<0.01	-	9.49	
Indeno(1,2,3-cd)pyrene	mg/kg	n.a.	-	0.04	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03	-	<0.03	
Dibenzo(ah)anthracene	mg/kg	n.a.	-	5.22	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	4.98	<0.03	<0.03	<0.03	<0.03	-	5.22	
Benzo(ghi)perylene	mg/kg	n.a.	-	15.8	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	15.8	<0.07	<0.07	<0.07	<0.07	-	13.9	
Total PAH (16)	mg/kg	n.a.	-	157	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	157	0.15	<0.08	<0.08	<0.08	-	115	
				0														
OCP+OPP Combined Pest Suite (Incl. Atrazine and Simazine)																		
Dichlorvos	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Mevinphos	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Tributyltin	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
alpha-Hexachlorocyclohexane (HCH)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Hexachlorobenzene (HCB)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Simazine	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Atrazine	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
beta-Hexachlorocyclohexane (HCH)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Quintozene (PCNB)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Chlorobenzene	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
delta-Hexachlorocyclohexane (HCH)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Triallate	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Heptachlor	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Aldrin	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Tetradifon	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Nitrofen	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Isodrin	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Pendimethalin	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Heptachlor epoxide	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
trans-Chlordane (Cis-nonac)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
o,p'-DDE (2,4)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Endosulphan I (Alpha)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
cis-Chlordane (Alpha)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
p,p'-DDE (4,4)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Dieldrin	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
o,p'-DDD (2,4)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Endrin	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Endosulphan II (Beta)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
p,p'-DDD (4,4)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
o,p'-DDT (2,4)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Endrin Aldehyde	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Endosulphan Sulphate	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
p,p'-DDT (4,4)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
p,p'-Methoxychlor	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
p,p'-Methoxychlor	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Permethrin I (cis)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Permethrin II (trans)	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Bioresmethrin	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Phosphamidon	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Ethion	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Carbophenothion	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Cypermethrin	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Fenvalerate I	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Fenvalerate II	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
Deltamethrin	mg/kg	n.a.	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	
				0														
Triazine Herbicides (x 8)																		
Atrazine	mg/kg			<0.02	<0.02	-	-	-	-	-	-	-	-	-	-	<0.02	-	
Cyanazine	mg/kg			<0.02	<0.02	-	-	-	-	-	-	-	-	-	-	<0.02	-	
Prometryn	mg/kg			<0.02	<0.02	-	-	-	-	-	-	-	-	-	-	<0.02	-	
Propazine	mg/kg			<0.02	<0.02	-	-	-	-	-	-	-	-	-	-	<0.02	-	
Terbuthrin	mg/kg			<0.02	<0.02	-	-	-	-	-	-	-	-	-	-	<0.02	-	
Simazine	mg/kg			<0.02	<0.02	-	-	-	-	-	-	-	-	-	-	<0.02	-	
Terbuthylazine	mg/kg			<0.02	<0.02	-	-	-	-	-	-	-	-	-	-	<0.02	-	
Terbutryn	mg/kg			<0.02	<0.02	-	-	-	-	-	-	-	-	-	-	<0.02	-	
				0														

* Assuming 1% SOM for organic compounds
** - Soil Organic Matter = Total Organic Carbon x 1.72

= Exceedance in relation to GAC for residential land use with homegrown produce (resi HGP)

NAD = No asbestos detected
MG = Made Ground
< = not tested
- = not applicable
n.a = no published value available

APPENDIX I – Geoenvironmental Analytical Laboratory Certificates

Geoenvironmental
Analytical Laboratory
Certificates

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 23/03613
Issue Number: 1 **Date:** 26 April, 2023

Client: RSK Environment Ltd (Leap Burgess Hill)
South Coast Regional Office,
Premier House,
Victoria Road
Burgess Hill,
West Sussex,
RH15 9LR

Project Manager: Adam Carr
Project Name: Twyford Bridge
Project Ref: LP3302
Order No: P02135470
Date Samples Received: 17/04/23
Date Instructions Received: 17/04/23
Date Analysis Completed: 26/04/23

Approved by:

[redacted]

Gemma Berrisford
Client Manager

Envirolab Job Number: 23/03613

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03613/1	23/03613/2	23/03613/3	23/03613/4	23/03613/5	23/03613/6	23/03613/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP101	TP102	TP105	TP106	TP108	TP109	TP111			
Depth to Top	0.10	0.40	0.10	2.10	0.20	0.15	0.10			
Depth To Bottom										
Date Sampled	12-Apr-23	12-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	4AE	5A	4AE	5A	1A	4ABE	4ABE			
% Stones >10mm$_A$	2.4	6.7	6.8	8.8	8.9	8.9	30.2	% w/w	0.1	A-T-044
pH$_D$$^{M\#}$	6.64	7.52	5.91	7.85	6.02	6.41	7.57	pH	0.01	A-T-031s
Total Organic Carbon$_D$$^{M\#}$	1.51	0.28	1.21	1.21	1.09	1.94	2.21	% w/w	0.03	A-T-032s
Arsenic$_D$$^{M\#}$	4	5	5	12	4	4	6	mg/kg	1	A-T-024s
Cadmium$_D$$^{M\#}$	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	mg/kg	0.5	A-T-024s
Copper$_D$$^{M\#}$	13	7	9	244	10	11	17	mg/kg	1	A-T-024s
Chromium$_D$$^{M\#}$	11	16	10	16	10	11	12	mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1	<1	<1	mg/kg	1	A-T-040s
Lead$_D$$^{M\#}$	22	11	20	305	17	18	61	mg/kg	1	A-T-024s
Mercury$_D$	0.32	<0.17	<0.17	4.53	<0.17	<0.17	0.59	mg/kg	0.17	A-T-024s
Nickel$_D$$^{M\#}$	9	13	7	23	7	8	10	mg/kg	1	A-T-024s
Selenium$_D$$^{M\#}$	<1	<1	<1	<1	<1	<1	1	mg/kg	1	A-T-024s
Zinc$_D$$^{M\#}$	46	34	37	6790	40	47	65	mg/kg	5	A-T-024s

Lab Sample ID	23/03613/1	23/03613/2	23/03613/3	23/03613/4	23/03613/5	23/03613/6	23/03613/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP101	TP102	TP105	TP106	TP108	TP109	TP111			
Depth to Top	0.10	0.40	0.10	2.10	0.20	0.15	0.10			
Depth To Bottom										
Date Sampled	12-Apr-23	12-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	4AE	5A	4AE	5A	1A	4ABE	4ABE			
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{D}^{\#}$	NAD	NAD	NAD	NAD	NAD	NAD	NAD			A-T-045
Asbestos Matrix (visual)$_{D}$	-	-	-	-	-	-	-			A-T-045
Asbestos Matrix (microscope)$_{D}$	-	-	-	-	-	-	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_{D}$	N/A	N/A	N/A	N/A	N/A	N/A	N/A			A-T-045
OCP+OPP Combined Pest Suite (incl. Atrazine and Simazine)										
Dichlobenil$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Tecnazene$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Trifluralin$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
alpha-Hexachlorocyclohexane (HCH)$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Hexachlorobenzene (HCB) $_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Simazine$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Atrazine$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
beta-Hexachlorocyclohexane (HCH)$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Quintozene (PCNB)$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Chlorothalonil$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
delta-Hexachlorocyclohexane (HCH)$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Triallate$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Heptachlor$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Aldrin$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Triadimefon$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Telodrin$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Isodrin$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Pendimethalin$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Heptachlor epoxide$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
trans-Chlordane (Gamma)$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
o,p-DDE (2,4)$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Endosulphan I (Alpha)$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
cis-Chlordane (Alpha)$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
p,p-DDE (4,4)$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Dieldrin$_{A}$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056

Envirolab Job Number: 23/03613

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03613/1	23/03613/2	23/03613/3	23/03613/4	23/03613/5	23/03613/6	23/03613/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP101	TP102	TP105	TP106	TP108	TP109	TP111			
Depth to Top	0.10	0.40	0.10	2.10	0.20	0.15	0.10			
Depth To Bottom										
Date Sampled	12-Apr-23	12-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	4AE	5A	4AE	5A	1A	4ABE	4ABE			
o,p-DDD (2,4)$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Endrin$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Endosulphan II (Beta)$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
p,p-DDD (4,4)$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
o,p-DDT (2,4)$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Endrin Aldehyde$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Endrin Ketone$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Endosulphan Sulphate$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
p,p-DDT (4,4)$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
o,p-Methoxychlor$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
p,p-Methoxychlor$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Permethrin I (cis)$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Permethrin II (trans)$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Dichlorvos$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Mevinphos$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Demeton-S$_A$	<0.50	-	-	-	-	-	-	mg/kg	0.5	A-T-056
Demeton-O$_A$	<0.50	-	-	-	-	-	-	mg/kg	0.5	A-T-056
Phorate$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Dimethoate$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Propetamphos$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Diazinon (Dimpylate)$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Disulfoton$_A$	<0.10	-	-	-	-	-	-	mg/kg	0.1	A-T-056
Chlorpyrifos-methyl$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Parathion (Ethyl Parathion)$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Methyl Parathion$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Pirimiphos-methyl$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Fenitrothion$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Fensulphothion$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Fenthion$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Malathion$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Chlorfenvinphos$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Chlorpyrifos$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Trichloronate$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Prothiofos (Tokuthion)$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056

Envirolab Job Number: 23/03613

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03613/1	23/03613/2	23/03613/3	23/03613/4	23/03613/5	23/03613/6	23/03613/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP101	TP102	TP105	TP106	TP108	TP109	TP111			
Depth to Top	0.10	0.40	0.10	2.10	0.20	0.15	0.10			
Depth To Bottom										
Date Sampled	12-Apr-23	12-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	4AE	5A	4AE	5A	1A	4ABE	4ABE			
Ethion$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Triazophos$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Carbophenothion$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Phosalone$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Azinphos-methyl$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Azinphos-ethyl$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056
Coumaphos$_A$	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-056

Envirolab Job Number: 23/03613

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03613/1	23/03613/2	23/03613/3	23/03613/4	23/03613/5	23/03613/6	23/03613/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP101	TP102	TP105	TP106	TP108	TP109	TP111			
Depth to Top	0.10	0.40	0.10	2.10	0.20	0.15	0.10			
Depth To Bottom										
Date Sampled	12-Apr-23	12-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	4AE	5A	4AE	5A	1A	4ABE	4ABE			
PAH-16MS										
Acenaphthene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.37	mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.25	mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	1.87	mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	16.4	mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	18.4	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	23.2	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	11.6	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	8.13	mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	17.4	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	3.61	mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	19.4	mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.32	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.03	<0.03	0.03	<0.03	<0.03	0.03	15.2	mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.04	mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	4.98	mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	15.8	mg/kg	0.07	A-T-019s
Total PAH-16MS$_A^{M\#}$	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	157	mg/kg	0.01	A-T-019s

Envirolab Job Number: 23/03613

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03613/1	23/03613/2	23/03613/3	23/03613/4	23/03613/5	23/03613/6	23/03613/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP101	TP102	TP105	TP106	TP108	TP109	TP111			
Depth to Top	0.10	0.40	0.10	2.10	0.20	0.15	0.10			
Depth To Bottom										
Date Sampled	12-Apr-23	12-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23	11-Apr-23			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	4AE	5A	4AE	5A	1A	4ABE	4ABE			
Triazine Herbicides (x 8)										
Atrazine$_A$	<0.02	-	-	-	-	-	-	mg/kg	0.02	Subcon RPS MH
Cyanazine$_A$	<0.02	-	-	-	-	-	-	mg/kg	0.02	Subcon RPS MH
Prometryn$_A$	<0.02	-	-	-	-	-	-	mg/kg	0.02	Subcon RPS MH
Propazine$_A$	<0.02	-	-	-	-	-	-	mg/kg	0.02	Subcon RPS MH
Trietazine$_A$	<0.02	-	-	-	-	-	-	mg/kg	0.02	Subcon RPS MH
Simazine$_A$	<0.02	-	-	-	-	-	-	mg/kg	0.02	Subcon RPS MH
Terbuthylazine$_A$	<0.02	-	-	-	-	-	-	mg/kg	0.02	Subcon RPS MH
Terbutryn$_A$	<0.02	-	-	-	-	-	-	mg/kg	0.02	Subcon RPS MH

Envirolab Job Number: 23/03613

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03613/8	23/03613/9	23/03613/10	23/03613/11	23/03613/12			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP113	TP115	TP116	WS106	WS103					
Depth to Top	0.15	0.50	0.15	0.10	0.10					
Depth To Bottom										
Date Sampled	11-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	4AE	1A	4AE	4ABE	4AE					
% Stones >10mm$_A$	19.4	6.8	<0.1	10.4	<0.1			% w/w	0.1	A-T-044
pH$_D$ M#	7.02	5.68	6.75	7.78	-			pH	0.01	A-T-031s
Total Organic Carbon$_D$ M#	1.00	0.34	1.88	2.20	-			% w/w	0.03	A-T-032s
Arsenic$_D$ M#	6	2	4	5	-			mg/kg	1	A-T-024s
Cadmium$_D$ M#	<0.5	<0.5	<0.5	<0.5	-			mg/kg	0.5	A-T-024s
Copper$_D$ M#	8	8	11	20	-			mg/kg	1	A-T-024s
Chromium$_D$ M#	18	16	15	14	-			mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	-			mg/kg	1	A-T-040s
Lead$_D$ M#	10	7	22	17	-			mg/kg	1	A-T-024s
Mercury$_D$	<0.17	<0.17	<0.17	<0.17	-			mg/kg	0.17	A-T-024s
Nickel$_D$ M#	15	14	9	13	-			mg/kg	1	A-T-024s
Selenium$_D$ M#	2	<1	<1	<1	-			mg/kg	1	A-T-024s
Zinc$_D$ M#	39	44	48	73	-			mg/kg	5	A-T-024s

Envirolab Job Number: 23/03613

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03613/8	23/03613/9	23/03613/10	23/03613/11	23/03613/12			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP113	TP115	TP116	WS106	WS103					
Depth to Top	0.15	0.50	0.15	0.10	0.10					
Depth To Bottom										
Date Sampled	11-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	4AE	1A	4AE	4ABE	4AE					
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{D}^{\#}$	NAD	NAD	NAD	NAD	-					A-T-045
Asbestos Matrix (visual)$_{D}$	-	-	-	-	-					A-T-045
Asbestos Matrix (microscope)$_{D}$	-	-	-	-	-					A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_{D}$	N/A	N/A	N/A	N/A	-					A-T-045
OCP+OPP Combined Pest Suite (incl. Atrazine and Simazine)										
Dichlobenil$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Tecnazene$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Trifluralin$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
alpha-Hexachlorocyclohexane (HCH)$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Hexachlorobenzene (HCB) $_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Simazine$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Atrazine$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
beta-Hexachlorocyclohexane (HCH)$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Quintozene (PCNB)$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Chlorothalonil$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
delta-Hexachlorocyclohexane (HCH)$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Triallate$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Heptachlor$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Aldrin$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Triadimefon$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Telodrin$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Isodrin$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Pendimethalin$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Heptachlor epoxide$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
trans-Chlordane (Gamma)$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
o,p-DDE (2,4)$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Endosulphan I (Alpha)$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
cis-Chlordane (Alpha)$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
p,p-DDE (4,4)$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Dieldrin$_{A}$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056

Lab Sample ID	23/03613/8	23/03613/9	23/03613/10	23/03613/11	23/03613/12			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP113	TP115	TP116	WS106	WS103					
Depth to Top	0.15	0.50	0.15	0.10	0.10					
Depth To Bottom										
Date Sampled	11-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	4AE	1A	4AE	4ABE	4AE					
o,p-DDD (2,4)$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Endrin$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Endosulphan II (Beta)$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
p,p-DDD (4,4)$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
o,p-DDT (2,4)$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Endrin Aldehyde$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Endrin Ketone$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Endosulphan Sulphate$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
p,p-DDT (4,4)$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
o,p-Methoxychlor$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
p,p-Methoxychlor$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Permethrin I (cis)$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Permethrin II (trans)$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Dichlorvos$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Mevinphos$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Demeton-S$_A$	-	-	-	-	<0.50			mg/kg	0.5	A-T-056
Demeton-O$_A$	-	-	-	-	<0.50			mg/kg	0.5	A-T-056
Phorate$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Dimethoate$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Propetamphos$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Diazinon (Dimpylate)$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Disulfoton$_A$	-	-	-	-	<0.10			mg/kg	0.1	A-T-056
Chlorpyrifos-methyl$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Parathion (Ethyl Parathion)$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Methyl Parathion$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Pirimiphos-methyl$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Fenitrothion$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Fensulphothion$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Fenthion$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Malathion$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Chlorfenvinphos$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Chlorpyrifos$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Trichloronate$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Prothiofos (Tokuthion)$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056

Envirolab Job Number: 23/03613 **Client Project Name: Twyford Bridge**

Client Project Ref: LP3302

Lab Sample ID	23/03613/8	23/03613/9	23/03613/10	23/03613/11	23/03613/12			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP113	TP115	TP116	WS106	WS103					
Depth to Top	0.15	0.50	0.15	0.10	0.10					
Depth To Bottom										
Date Sampled	11-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	4AE	1A	4AE	4ABE	4AE					
Ethion$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Triazophos$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Carbophenothion$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Phosalone$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Azinphos-methyl$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Azinphos-ethyl$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056
Coumaphos$_A$	-	-	-	-	<0.01			mg/kg	0.01	A-T-056

Envirolab Job Number: 23/03613

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03613/8	23/03613/9	23/03613/10	23/03613/11	23/03613/12			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP113	TP115	TP116	WS106	WS103					
Depth to Top	0.15	0.50	0.15	0.10	0.10					
Depth To Bottom										
Date Sampled	11-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	4AE	1A	4AE	4ABE	4AE					
PAH-16MS										
Acenaphthene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	-			mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	-			mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	<0.02	<0.02	<0.02	<0.02	-			mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	-			mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.05	<0.04	<0.04	<0.04	-			mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.06	<0.05	<0.05	<0.05	-			mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05	<0.05	<0.05	<0.05	-			mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	<0.07	<0.07	<0.07	-			mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	<0.06	<0.06	<0.06	<0.06	-			mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	-			mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	<0.08	<0.08	<0.08	-			mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	-			mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.04	<0.03	<0.03	<0.03	-			mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	-			mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	-			mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	<0.07	<0.07	<0.07	<0.07	-			mg/kg	0.07	A-T-019s
Total PAH-16MS$_A^{M\#}$	0.15	<0.08	<0.08	<0.08	-			mg/kg	0.01	A-T-019s

Envirolab Job Number: 23/03613

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03613/8	23/03613/9	23/03613/10	23/03613/11	23/03613/12			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP113	TP115	TP116	WS106	WS103					
Depth to Top	0.15	0.50	0.15	0.10	0.10					
Depth To Bottom										
Date Sampled	11-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23	12-Apr-23					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	4AE	1A	4AE	4ABE	4AE					
Triazine Herbicides (x 8)										
Atrazine$_A$	-	-	-	-	<0.02			mg/kg	0.02	Subcon RPS MH
Cyanazine$_A$	-	-	-	-	<0.02			mg/kg	0.02	Subcon RPS MH
Prometryn$_A$	-	-	-	-	<0.02			mg/kg	0.02	Subcon RPS MH
Propazine$_A$	-	-	-	-	<0.02			mg/kg	0.02	Subcon RPS MH
Trietazine$_A$	-	-	-	-	<0.02			mg/kg	0.02	Subcon RPS MH
Simazine$_A$	-	-	-	-	<0.02			mg/kg	0.02	Subcon RPS MH
Terbuthylazine$_A$	-	-	-	-	<0.02			mg/kg	0.02	Subcon RPS MH
Terbutryn$_A$	-	-	-	-	<0.02			mg/kg	0.02	Subcon RPS MH

REPORT NOTES

General

This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.
The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample, 9 = INCINERATOR ASH.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,
E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve
Subscript "^" indicates analysis has dependant options against results. Testing dependant on results appear in the comments area of your sample receipt.
EPH CWG results have humics mathematically subtracted through instrument calculation
TPH results "with Cleanup" indicates results cleaned up with Silica during extraction

EPH CWG GCxGC ID from TPH CWG

Where we have identified humic substances in any ID's from TPH CWG with Clean Up please note that the concentration of these humic substances is not included in the quantified results and are included in the ID for information.

Please contact us if you need any further information.

v2

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: RSK Environment Ltd (Leap Burgess Hill), South Coast Regional Office, Premier House, Victoria Road, Burgess Hill, West Sussex, RH15 9LR

Project: Twyford Bridge

Clients Project No: LP3302

Project No: 23/03613

Date Received: 17/04/2023 (am)

Cool Box Temperatures (°C): 12.6 & 13.0

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	23/03613/1	23/03613/2	23/03613/3	23/03613/4	23/03613/5	23/03613/6	23/03613/7	23/03613/8	23/03613/9	23/03613/10	23/03613/11	23/03613/12
Client Sample No												
Client Sample ID/Depth	TP101 0.10m	TP102 0.40m	TP105 0.10m	TP106 2.10m	TP108 0.20m	TP109 0.15m	TP111 0.10m	TP113 0.15m	TP115 0.50m	TP116 0.15m	WS106 0.10m	WS103 0.10m
Date Sampled	12/04/23	12/04/23	11/04/23	11/04/23	11/04/23	11/04/23	11/04/23	11/04/23	12/04/23	12/04/23	12/04/23	12/04/23
A-T-019s	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	
A-T-024s	24/04/2023	24/04/2023	24/04/2023	25/04/2023	24/04/2023	24/04/2023	24/04/2023	24/04/2023	24/04/2023	24/04/2023	24/04/2023	
A-T-031s	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	
A-T-032s	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	
A-T-040s	22/04/2023	22/04/2023	22/04/2023	22/04/2023	22/04/2023	22/04/2023	22/04/2023	22/04/2023	22/04/2023	22/04/2023	22/04/2023	
A-T-044	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023	20/04/2023
A-T-045	18/04/2023	18/04/2023	18/04/2023	18/04/2023	18/04/2023	18/04/2023	18/04/2023	18/04/2023	18/04/2023	18/04/2023	18/04/2023	
A-T-056	20/04/2023											20/04/2023

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 23/03740
Issue Number: 1 **Date:** 26 April, 2023

Client: RSK Environment Ltd (Leap Burgess Hill)
South Coast Regional Office,
Premier House,
Victoria Road
Burgess Hill,
West Sussex,
RH15 9LR

Project Manager: Adam Carr
Project Name: Twyford Bridge
Project Ref: LP3302
Order No: P02135470
Date Samples Received: 20/04/23
Date Instructions Received: 20/04/23
Date Analysis Completed: 26/04/23

Client Manager

Envirolab Job Number: 23/03740

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03740/1							Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP111									
Depth to Top	0.55									
Depth To Bottom										
Date Sampled	11-Apr-23									
Sample Type	Solid									
Sample Matrix Code	7									
% Stones >10mm$_A$	<0.1							% w/w	0.1	A-T-044
pH$_D$$^{M\#}$	8.05							pH	0.01	A-T-031s
Total Organic Carbon$_D$$^{M\#}$	1.38							% w/w	0.03	A-T-032s
Arsenic$_D$$^{M\#}$	<1							mg/kg	1	A-T-024s
Cadmium$_D$$^{M\#}$	<0.5							mg/kg	0.5	A-T-024s
Copper$_D$$^{M\#}$	12							mg/kg	1	A-T-024s
Chromium$_D$$^{M\#}$	31							mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1							mg/kg	1	A-T-040s
Lead$_D$$^{M\#}$	33							mg/kg	1	A-T-024s
Mercury$_D$	4.15							mg/kg	0.17	A-T-024s
Nickel$_D$$^{M\#}$	21							mg/kg	1	A-T-024s
Selenium$_D$$^{M\#}$	<1							mg/kg	1	A-T-024s
Zinc$_D$$^{M\#}$	77							mg/kg	5	A-T-024s

Envirolab Job Number: 23/03740

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03740/1							Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP111									
Depth to Top	0.55									
Depth To Bottom										
Date Sampled	11-Apr-23									
Sample Type	Solid									
Sample Matrix Code	7									
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_D^{\#}$	NAD									A-T-045
Asbestos Matrix (visual)$_D$	-									A-T-045
Asbestos Matrix (microscope)$_D$	-									A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_D$	N/A									A-T-045

Envirolab Job Number: 23/03740

Client Project Name: Twyford Bridge

Client Project Ref: LP3302

Lab Sample ID	23/03740/1							Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP111									
Depth to Top	0.55									
Depth To Bottom										
Date Sampled	11-Apr-23									
Sample Type	Solid									
Sample Matrix Code	7									
PAH-16MS										
Acenaphthene$_A^{M\#}$	0.45							mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	0.14							mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	1.71							mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	11.4							mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	12.2							mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	15.6							mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	7.82							mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	5.87							mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	10.8							mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	2.19							mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	17.8							mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	0.43							mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	9.49							mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	<0.03							mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	5.22							mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	13.9							mg/kg	0.07	A-T-019s
Total PAH-16MS$_A^{M\#}$	115							mg/kg	0.01	A-T-019s

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TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
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Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
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Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,
E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve
Subscript "^" indicates analysis has dependant options against results. Testing dependant on results appear in the comments area of your sample receipt.
EPH CWG results have humics mathematically subtracted through instrument calculation
TPH results "with Cleanup" indicates results cleaned up with Silica during extraction

EPH CWG GCxGC ID from TPH CWG

Where we have identified humic substances in any ID's from TPH CWG with Clean Up please note that the concentration of these humic substances is not included in the quantified results and are included in the ID for information.

Please contact us if you need any further information.

v2

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: RSK Environment Ltd (Leap Burgess Hill), South Coast Regional Office, Premier House, Victoria Road, Burgess Hill, West Sussex, RH15 9LR

Project: Twyford Bridge

Clients Project No: LP3302

Project No: 23/03740

Date Received: 20/04/2023 (am)

Cool Box Temperatures (°C): 10.6

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	23/03740/1
Client Sample No	
Client Sample ID/Depth	TP111 0.55m
Date Sampled	11/04/23
A-T-019s	25/04/2023
A-T-024s	26/04/2023
A-T-031s	26/04/2023
A-T-032s	25/04/2023
A-T-040s	26/04/2023
A-T-044	26/04/2023
A-T-045	21/04/2023

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

APPENDIX J – Approach to the Selection of Generic Assessment Criteria

Approach to the Selection of Generic Assessment Criteria

LEAP APPROACH TO THE SELECTION OF GENERIC ASSESSMENT CRITERIA

Chronic Risks to Human Health

Defra and the EA have published a limited number of Soil Guideline Values (SGVs)[26] that represent minimal chronic risk to human health. CL:AIRE has published a limited number of Category Four Screening Levels (C4SLs)[27] which represent a low but still strongly precautionary level of chronic risk to human health. Both the SGVs and C4SLs have both been derived for a Soil Organic Matter (SOM) content of 6%, which is not always representative of the low SOM that are encountered within Made Ground on brownfield sites.

Land Quality Management Ltd. (LQM) responded to the demand for a more comprehensive set of screening values and for a wider range of SOM by producing Suitable for Use Levels (S4ULs)[28] which are a hybrid of SGVs and C4SLs. The S4ULs have been endorsed by the Chartered Institute of Environmental Health (CIEH).

A smaller set of 35 GACs was published by CL:AIRE in association with AGS and EIC in 2010. These were based on the exposure scenarios that were used to derive the SGVs. These exposure scenarios have since been superseded, in part, by the publication of the C4SLs and the S4ULs. A second phase of C4SLs is currently under development.

LEAP uses C4SLs where they are available as generic assessment criteria to quantitatively assess the potential chronic risks to human health. Where C4SLs are not available, the S4ULs or CL:AIRE GACs are used. It is noted that S4ULs are not equivalent to C4SLs in all their exposure assumptions but are generally more conservative. To ensure the greatest possible consistency in LEAP's human health GQRAs, the physicochemical and toxicological input parameters that were used to derive the CL:AIRE GACs have been re-modelled using the exposure parameters selected by LQM to derive the S4ULs.

For the organic compounds benzene and benzo(a)pyrene) for which C4SLs are available for a SOM of 6% only, LEAP has calculated equivalent C4SLs for 1% and 2.5% SOM. SOM does not affect the inorganic contaminants.

[26] Environment Agency Science Report SC050021 series.

[27] CL:AIRE Final Project Report. 'SP1010 – Development of Category 4 Screening Levels for assessment of land affected by contamination'. CL:AIRE, December 2013

[28] 'The LQM/CIEH S4ULs for Human Health Risk Assessment', Nathaniel P et al, 2015. Copyright Land Quality Management Ltd, reproduced with permission: Publication Number S4UL3509.

In accordance with current Public Health England (PHE) guidance[29], LEAP carries out the assessment of PAHs using a surrogate marker approach, whereby the assessment of risk from benzo(a)pyrene also captures potential risks from other carcinogenic PAHs that may be present. The alternative S4ULs for PAHs using the Toxic Equivalent Factor (TEF) approach are not used because this approach is likely to under predict the true carcinogenicity of PAHs and is not advocated by PHE. The threshold PAHs have been assessed similarly, by using naphthalene as a marker compound due to its high volatility relative to other PAHs.

Total phenols are assessed by LEAP against the S4UL for phenol and total chromium is assessed against the S4UL for trivalent chromium.

LEAP does not consider the theoretical soil saturations in the evaluation of organic compounds and as such, some of the S4ULs for the less sensitive exposure scenarios are lower than their more sensitive equivalents.

Risks to human health from inhalation of vapours derived from groundwater are evaluated by LEAP using the SoBRA groundwater GAC_{gwvap}[30].

Acute Risks to Human Health

Cyanide has not been modelled using CLEA because it has high acute toxicity and CLEA is designed to evaluate chronic risks. Assuming an acute risk and based on a single dose of 3 g of soil, an assessment criterion of 33 $mgkg^{-1}$ free inorganic cyanide and 544 $mgkg^{-1}$ complex cyanide has been calculated by LEAP. At this stage LEAP has chosen to adopt a conservative screening value of 20 $mgkg^{-1}$ for total cyanide (essentially the sum of free and complex cyanides) to highlight any potential risks to human health.

Risks to Controlled Waters

RTM (2006)[31] requires receptor-specific Water Quality Standards (WQS) to be used to determine potentially unacceptable risks to water bodies in England and Wales. It requires appropriate criteria to be taken from a hierarchy of sources, where they are available as follows:

---

[29] HPA 'Contaminated Land Information Sheet. Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)'. Public Health England, 2017.

[30] Society of Brownfield Risk Assessment (SoBRA) 'Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health from Volatile Contaminants in Groundwater' Version 1.0. February 2017.

[31] EA 'Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination' 2006.

1. UK published values
2. EU published values
3. WHO published values

Drinking Water Resources

For groundwater and surface waters that are abstracted for potable supply LEAP uses:

- UK Drinking Water Quality Standards (DWS) from *The Water Supply (Water Quality) Regulations* 2016 (England).
- *The Water Supply (Water Quality) Regulations* 2010 (Wales) as amended in 2016.
- World Health Organisation *Guidelines for Drinking Water Quality*, Fourth Edition, Volume 1, (2011).

Where the groundwater is not abstracted for potable supply, this is a precautionary approach which protects the potential future exploitation of the groundwater.

Surface Water (Ecological) Receptors

For surface waters as ecological receptors, LEAP uses the Environmental Quality Standards (EQS) from The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015. There are no appropriate EU or WHO standards available.

Petroleum Hydrocarbons

There are no current UK standards available for petroleum hydrocarbons, either for groundwater or surface water receptors, so an initial assessment criterion of 10µg/l, based on the former target concentration for dissolved or emulsified hydrocarbons, is used to represent a conservative preliminary screening value for total petroleum hydrocarbons.

Where considered appropriate, LEAP then follows the guidance of CL:AIRE 2017[32] for the further assessment of the petroleum hydrocarbon fractions and derivatives. For a drinking water resource, the WHO guidelines are used. For surface waters as ecological receptors, proxy compounds are used to select appropriate EQS based on recommended indicator compounds, as follows:

- Aromatic EC5-EC7 – benzene
- Aromatic >EC7-EC8 – toluene

[32] CL:AIRE, 2017. 'Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies'. CL:AIRE, London. ISBN 978-1-905046-31-7.

- Aromatic >EC8-EC10 – ethylbenzene
- Aromatic >EC10-EC12 – naphthalene
- Aromatic >EC12-EC16 – no proxy
- Aromatic >EC16-EC21 – anthracene
- Aromatic >EC21-EC35 – benzo(a)pyrene