

FLOOD RISK ASSESSMENT

Land South of Mortimers Lane, Fair Oak, Eastleigh



Prepared for: Bloor Homes Southern
Ref: 022_8230679_SI_Flood_Risk_Assessment

Document History

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1.0 Introduction

- 1.1 This report has been prepared by Glanville Consultants on behalf of Bloor Homes Southern to accompany an outline application for up to 245 dwellings (Use Class C3), up to 350sqm multi-functional space, and mobility infrastructure (Use Class Sui Generis) with associated open space, landscaping, infrastructure, and vehicular access off Mortimers Lane, Fair Oak; all matters reserved except for vehicular access off Mortimers Lane and pedestrian/cycle connections to the site boundary.
- 1.2 The purpose of this document is to assess the existing level of flood risk to the site and its surroundings within the context of the development proposals. This report also defines the principles of the surface water drainage scheme for the proposed development in order to demonstrate compliance with both national and local policy requirements in terms of drainage and flood risk. Drainage is a matter reserved within the application and this report is therefore indicative only and does not constitute a full detailed design.
- 1.3 This assessment has been prepared in accordance with the National Planning Policy Framework (NPPF) and the Planning Policy Framework (PPG) to the NPPF. Local policy concerning flood risk and drainage has also been considered, in fulfilment of the guidance set out in Parts 1 and 8 of the Partnership for South Hampshire (PfSH) Level 1 Strategic Flood Risk Assessment (SFRA), which forms the Eastleigh Borough Council (EBC) SFRA.
- 1.4 Pre-application advice has also been sought from Hampshire County Council (HCC) in its role as Lead Local Flood Authority (LLFA) for the area surrounding the site. This report has been prepared in compliance with the strategy discussed with the LLFA.
- 1.5 This assessment was undertaken with reference to information provided and/or published by the following bodies:
- Ordnance Survey;
 - British Geological Survey;
 - Hampshire County Council;
 - Partnership for South Hampshire
 - Environment Agency.
- 1.6 This report concludes that the proposed development is not at risk of flooding; can be developed safely without increasing flood risk elsewhere; and that the development proposals comply with relevant planning policy concerning flood risk and drainage.

2.0 Site Description & Development Proposals

Site Description

- 2.1 The site is located on land to the south of Mortimers Lane, Fair Oak, Eastleigh. The site measures 11.05ha, with the approximate centre of the site is located at Ordnance Survey National Grid reference SU 50679 18685. The site is located to the south of Mortimers Lane, which forms the site's northern boundary, and is located within the SO50 7EA postcode.
- 2.2 The site is bound to the north by Mortimers Lane (B3037). Further North beyond Mortimers Lane lays the residential development known as 'Pembers Hill Park'.
- 2.3 A group of Grade II listed buildings, associated with the Mortimer farmstead, lies to the north-east and are subject to a recent planning approval for alterations, extensions and conversion of 4 existing barns and the construction of 5 new dwellings within their curtilage.
- 2.4 To the east lies East Horton Golf Club. Characteristic of all golf courses, the course has been sculpted and heavily managed and maintained.
- 2.5 Abutting the site to the west are two recent residential developments, known as 'Pembers Hill Drive' and 'East Knowle'. Further west lays Knowle Hill Conservation Area which includes a car park, picnic area and permissive footpaths which lead through woodland to Knowle Park, a 14 ha. country park and important local recreational asset.
- 2.6 Immediately south of the site lays East Horton Business Park, Deer Farm Park Industrial Estate. A new development of fifteen business units abutting the southern site boundary and form an extension to East Horton Business Park. This site was granted planning permission for general industrial buildings (Use Class B2) in July 2023 and has since been built out.
- 2.7 Adjacent to the business park lays the Knowle Lane Local Wildlife Site (LWS). Designated on account of the woodland and grassland it supports. It includes a woodland and large pond.

Topographical Survey

- 2.8 A topographical survey was carried out by Sitaline in December 2022, which indicates that the site generally falls towards south-east. The site falls sharply in places, with the high point located towards the north-western corner at approximately 60.11m Above Ordnance Datum (AOD), while the low point is located in the south-eastern corner at approximately 40.99m AOD. The topographical survey is provided in Appendix B.
- 2.9 The topographical survey shows that the site has drainage ditches running south or south east along every boundary, including a small ditch running south-east within the site at the boundary between the two fields that make up the site.
- 2.10 Vehicular access to the site is taken from Mortimers Lane along the northern boundary. The survey shows Mortimers Lane currently drains via two separate ditches on both the northern and southern side of the carriageway, with several grips cut into the southern verge to allow water to run-off into the ditch along the site's northern boundary. This ditch is then culverted beneath the existing access to the site, before continuing eastwards.

- 2.10 Vehicular access to the site is taken from Mortimers Lane along the northern boundary. The survey shows Mortimers Lane currently drains via two separate ditches on both the northern and southern side of the carriageway, with several grips cut into the southern verge to allow water to run-off into the ditch along the site's northern boundary. This ditch is then culverted beneath the existing access to the site, before continuing eastwards.

Ground Conditions

- 2.11 Geological records published by the British Geological Survey (BGS) indicate the site is underlain by bedrock geology comprising clay, silt and sand from London Clay Formation, with a narrow band of Whitecliff Sand Member in the centre of the site, close to the existing tree line separating fields.
- 2.12 Soils mapping provided by Cranfield University on behalf of DEFRA shows that the site of the proposed development falls on HOST soil class 8, which is described as "Slightly acid loamy and clayey soils with impeded drainage", and HOST soil class 18, which is described as "Slowly permeable seasonally wet slight acid but base-rich loamy and clayey soils".
- 2.13 An intrusive site investigation was undertaken by Geo-Environmental Services Limited in December 2022 which includes trial pits and boreholes being sunk on-site to assess the underlying geology and check groundwater levels. Groundwater monitoring was undertaken through the winter months of 2022/2023.
- 2.14 The ground conditions recorded on-site is summarised as the following: topsoil to depths between 0.25m below ground level (bgl) and 0.30m bgl over London Clay Formation, consisting of clay, silt and sand to the depth of the boreholes at 5.00m bgl. The Whitecliff Sand member shown on the BGS mapping was not encountered in any location.
- 2.15 Groundwater was encountered during ground investigation works at depths between 3.00m bgl to 5.00m bgl, with return visits to the site between December and April recording groundwater levels either at or close to the surface in two locations at the southern boundary of the site. During this time the soil in this southern part of the site, which is topographically the lowest area, was naturally saturated, soft, and wet under foot. However there was no report of standing water or flooding above ground. The site investigation report is included in Appendix C.

Hydrological and Hydrogeological Context

- 2.16 The Environment Agency (EA) defines Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from activities that might cause pollution in the area. The SPZs mapping indicates that the site is not located within a SPZ.
- 2.17 A Nitrate Vulnerable Zone (NVZ) is a conservative designation for areas of land that drain to nitrate polluted waters or waters which could become polluted by nitrates. The NVZ mapping indicates that the site is located within a NVZ.
- 2.18 The site has been subject to a nutrient neutrality assessment for nitrate pollution by EDP, and their report and calculations are included in the planning application. Please refer to EDP's report for further details.

- 2.19 The EA defines Drinking Water Safeguard Zones (SgZs) for water sources used for public drinking water supply. SgZs are catchment areas that influence the water quality for their respective Drinking Water Protected Area, which are at risk of failing the drinking water protection objectives. These non-statutory SgZs are where action to address water contamination will be targeted, so that extra treatment by water companies can be avoided. The site is not located within a SgZ or DWPA.
- 2.20 Groundwater vulnerability mapping published by the EA indicates the risk to groundwater from any potential pollutants on-site reaching the underlying aquifer. The mapping shows that the majority of the site is highlighted as unproductive, however the area highlighted on the broad-scale BGS mapping as being Whitecliff Sand Member is shown to be an area of high vulnerability.
- 2.21 The bedrock Aquifer Designation Map published by the EA indicates that the bedrock underlying the site is classed as an Unproductive Strata, with the area associated with the Whitecliff Sand Member classed as Secondary A Aquifer. Unproductive Strata indicates regions where layers of rock or drift deposits have low permeability and have negligible influence on water supply or river base flow.
- 2.22 As mentioned previously, the sand member soils were not encountered on-site during the site investigation and are not thought to be present. There is therefore no connectivity identified between the site soils and the vulnerable Secondary A Aquifer. As a result there is negligible risk of adverse impact on the quality of the aquifer as a result of development at the site.

Development Proposals

- 2.23 The proposed development is an outline application for up to 245 dwellings (Use Class C3), up to 350sqm multi-functional space, and mobility infrastructure (Use Class Sui Generis) with associated open space, landscaping, infrastructure, and vehicular access off Mortimers Lane, Fair Oak; all matters reserved except for vehicular access off Mortimers Lane and pedestrian/cycle connections to the site boundary.
- 2.24 A layout parameter plan showing the vehicular access from Mortimers Lane and areas of land use within the site is given in Appendix D.

3.0 Planning Policy and Guidance

- 3.1 Set out below is a summary of the national and local planning policy and guidance relating to flood risk and surface water management that are relevant to the development proposals.

National

- 3.2 At a national level, the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG) to the NPPF ensure flood risk is taken into account at all stages of the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development towards areas at lowest flood risk. The NPPF retains a risk based approach to the planning process and defines four Flood Zones to be used as the basis for applying the sequential test to consider a development in terms of Flood Risk Vulnerability Classifications, which define the type of development that is considered appropriate within each zone.
- 3.3 The NPPF establishes the Flood Zones as the starting point for assessment with the overarching aim to steer new development to areas with the lowest probability of flooding. The Flood zones are defined as follows:
- Flood Zone 1 (Low Probability) comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (>0.1%).
 - Flood Zone 2 (Medium Probability) comprises land assessed as having between a 1 in 1000 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%) in any year.
 - Flood Zone 3a (High Probability) comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
 - Flood Zone 3b (The Functional Floodplain) comprises land where water has to flow or be stored in times of flood.

Local Policy and Guidance

Partnership for South Hampshire (PfSH) Level 1 Strategic Flood Risk Assessment (SFRA) Part 1 Main Report – February 2024

PfSH Level 1 SFRA Part 8 Eastleigh Borough Council (EBC) – November 2023

- 3.4 This Level 1 SFRA aims to collect and present information to define flood risk within the administrative areas in South Hampshire and make recommendations for policies and guidance for the effective management of flood risk to property and life. The SFRA includes flood maps covering the entire district as well as strategic sites and key settlements. It also summarises the flood risk from each source of flooding within the administrative areas of South Hampshire.
- 3.5 The SFRA is published in two reports and, when read together, form the SFRA for EBC's administrative area. The Part 8 report provides guidance and outlines policies specific to EBC.

Hampshire County Council (HCC) Pre-application Advice comments – January 2024

- 3.6 Pre-application advice was sought from HCC in its role as LLFA. A pre-application Technical Note concerning flood risk and drainage (report ref: 003_8230679_LM_Pre-application_Technical_Note) was prepared prior to a site meeting between the LLFA and Glanville in January 2024. The pre-application technical note, meeting notes, and LLFA response are included in Appendix E of this report.
- 3.7 It was agreed that infiltration drainage is unlikely to be meaningful on this site. Given the ground conditions and information gathered to date, the LLFA agree that infiltration can be eliminated as a feasible option without the need for infiltration testing to be provided show the exact infiltration rates.
- 3.8 The LLFA agree that a restricted discharge to the local ditches and watercourses surrounding the site is the most sensible strategy to pursue for this site.
- 3.9 The LLFA advised that they expect rainfall predictions to be given an additional allowance of +45% on the 1% AEP storm to account for the effects of climate change, in line with the latest guidance for the East Hampshire management Catchment.
- 3.10 Given the natural slope of the site, the LLFA advised that while open SuDS features are preferred, they will not reject a surface water drainage strategy which includes some below ground and crated attenuation in order to allow sufficient attenuation volumes on-site.
- 3.11 Shallow side slopes to open SuDS features were the LLFA's stated preference, however where steeper slopes and/or retaining walls are proposed to SuDS they will consider the proposals provided it is clear how safety and maintenance will be managed. While these details are not usually considered at outline application stage, where specific details are submitted, the LLFA agreed to provide approval or comment at this stage to assure other statutory consultees (e.g. ecology and landscape officers) that the proposals will be relied upon at a later stage in the planning process.
- 3.12 Culverting of ditches must be kept to a minimum and wider culverting beyond the enabling of site highway works will not be considered acceptable. Ordinary Watercourse Consent (OWC) will be required for any culvert, as well as additional consents for additional headwalls/outlets to a ditch or watercourse. The OWC process is separate from the planning process, but the LLFA will likely provide comments reminding the developer of their obligations as part of the planning process.

4.0 Sources of Potential Flooding

- 4.1 Flood risk to the site is considered from all likely sources of flooding, as defined in the NPPF and the PPG to the NPPF. These include tidal, fluvial, surface water, artificial sources, sewer and groundwater. The following paragraphs consider flood risk to the site from all these sources.

Tidal/Coastal

- 4.2 Given that there is no tidally influenced watercourses on or within the vicinity of the site, tidal flooding is not an issue that would prevent the development of the site.

Fluvial

- 4.3 The EA publishes its Flood Map for Planning on the GOV.UK website which shows the maximum extent of fluvial flooding. The mapping indicates that the entire site is located within Flood Zone 1, beyond the limits of the 1 in 1,000 fluvial flood event (<0.1%). An extract of the EA mapping is included in Appendix F. It is therefore concluded that risk posed from fluvial flooding to the development is very low.

Surface Water

- 4.4 The EA publishes a Flood Risk from Surface Water map on the GOV.UK website which indicates the predicted risk of surface water flooding in the event that rainwater does not drain away through normal drainage systems or soak into the ground. The mapping indicates that the majority of the site is at 'very low' risk of surface water flooding, with an annual probability of flooding of less than 1:1,000.
- 4.5 The Flood Risk from Surface Water Map does highlight a few areas of 'low' risk (between 1:100 and 1,000 annual probability), 'medium' (between 1:30 and 1:100 annual probability), and 'high' (greater than 1:30 annual probability) risk along some of the ditches at the site boundaries. An extract from the surface water flood mapping is included in Appendix G. It can be seen that the flood risk shown is located very tightly along the ditches only and the steep gradient of the site makes it impossible for surface water filling the ditches to spread across any significant area of the site. Provided the site layout allows for sensible buffer to the drainage ditches and the flood levels of units remain above the ditch levels, there is negligible risk that the very minor surface water flood risk shown on the map could cause risk to the proposed residential development.

Artificial Sources (Reservoir)

- 4.6 The EA publishes indicative mapping on the GOV.UK website which shows the maximum extent of reservoir flooding in the unlikely event that a reservoir should fail. The mapping indicates that the site is located outside of a reservoir flood area and therefore the risk of flooding from this source is negligible.

Sewer

- 4.7 The EBC SFRA includes mapping highlighting instances of flooding recorded by Southern Water (Appendix A, Figure 2B). The mapping indicates two recorded incidents of sewer flooding approximately 655m to the west of the site. There are no recorded instances of flooding within the site boundary and, according to the sewerage records obtained, there is no sewerage infrastructure present within the site boundary. A copy of the sewer records is included in Appendix H.

- 4.8 The EBC mapping also includes recorded outlines of highway flooding (Appendix A, Figure 3B). The mapping shows highway flooding in Mortimers Lane to the west of the site which the SFRA suggests was due to culvert blocking– this flooding is beyond Knowle Lane and is therefore in a separate catchment to the site. The associated risk of sewer flooding occurring on site is therefore considered to be very low.
- 4.9 The proposed new sewer connection to the existing public sewer is via a proposed new rising main. The pump infrastructure and valves will act as a non-return valve and prevent any possibility of flooding at the site as a result of a flooded sewer network downstream.

Groundwater

- 4.10 The EBC SFRA includes the BGS Susceptibility to Groundwater Flooding dataset in order to ascertain areas considered to be most susceptible to groundwater flooding. The dataset is split into four categories, as described below:
- Classification A – Limited potential for groundwater flooding to occur.
 - Classification B – Potential for groundwater flooding of property situated below ground level
 - Classification C – Potential for groundwater flooding to occur at surface
 - Classification D – Not considered to be prone to groundwater flooding: based on rock type.
- 4.11 The dataset is illustrated in Appendix A of the SFRA (Figure 5B). The mapping shows the majority site is located within an area not considered to be prone to groundwater flooding, with a small area in the north of the site shown to have limited potential.
- 4.12 While groundwater monitoring performed at the site recorded groundwater levels within 1.00m of the ground surface, there was no sign of emergence or standing water at the site surface.
- 4.13 Given that the soils are impervious, and known not to be prone to groundwater flooding, it is not thought that the water levels observed in groundwater monitoring represented a coherent water table emerging from the site subsurface. The winter of 2023/2024 had been exceptionally wet, and it is already known that the site geology does not allow rainfall to infiltrate into the ground. Therefore the water observed within the site surface soils during the investigation period is thought to result from rainfall saturating the heavy, soft soils that was unable to drain away, rather than “true” groundwater.
- 4.14 Overall therefore the risk of groundwater flooding to the site surface is considered to be very low.
- 4.15 The investigation into ground and groundwater conditions does indicate that soils in the lowest part of the site are prone to becoming saturated and waterlogged, and gardens and landscaping areas in this part of the site will need to be designed with this in mind.

Historic Flooding

The PfSH Level 1 SFRA includes historical flood records and indicates the site has not been affected by a historic flood event. Furthermore, HCC reviewed their records of flood incidents for this area as part of the pre-application process and have no records of flooding within a 250m radius of the site.

Summary

- 4.16 The site is located entirely within Flood Zone 1, which is land at the lowest risk of fluvial flooding. All other sources of flooding identified are considered to present a low to negligible risk to the site. It is therefore considered that the site can be developed safely in accordance with National and Local planning policy concerning flood risk.



5.0 Flood Risk Assessment

- 5.1 The NPPF and the PPG to the NPPF ensure flood risk is taken into account at all stages of the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development towards areas at lowest flood risk. The NPPF encourages a sequential, risk-based approach to determine the suitability of land for development. This document advises that the development of sites within Flood Zone 1 should be given preference where available.
- 5.2 Table 2 of the Planning Practice Guidance to the NPPF categorises different types of development into five flood risk vulnerability classifications:
- Essential Infrastructure;
 - Highly Vulnerable;
 - More Vulnerable;
 - Less Vulnerable; and
 - Water Compatible Development.
- 5.3 The NPPF classifies the proposed residential use of the site as being 'More Vulnerable'.
- 5.4 As discussed in Section 4, all proposed dwellings are located entirely within Flood Zone 1. Table 3 of the PPG states that all uses are appropriate for Flood Zone 1. Therefore, the proposed development use is compatible with the flood zone of the site and developing the site for its intended purposes is considered appropriate in terms of flood risk. As such, the Sequential Test and Exception Test are not required to be applied to this development
- 5.5 Built development along the boundaries with the ditches/ordinary watercourses will be avoided to ensure that all dwellings are located in areas of "very low" surface water flood risk. Built development and finished floor levels will be raised by circa 300-600mm above existing levels close to the existing ditches in order to ensure that they cannot be affected by high water levels within the ditch.
- 5.6 In addition, gardens and landscaped areas along the southern boundary of the site will be designed with saturated winter soils in mind, with levels raised and drainage layers added where winter use of the area is required, and this area otherwise designated as a wild zone which does not allow for winter use.
- 5.7 A review of all sources of potential flooding in Section 4 of this assessment has concluded that there is at low to very low risk to the proposed development from all other sources of flooding examined. As such, the proposals are considered to comply with National and Local planning policy concerning flood risk.

6.0 Surface Water Drainage

- 6.1 This section outlines the drainage strategy for the disposal of surface water from the proposed development. This strategy has been developed in-line with all relevant national and local standards and guidance, including the CIRIA SuDS Manual, Defra's Non-Statutory Technical Standards for Sustainable Drainage Systems, Technical Guidance to the NPPF, and Part H of the Building Regulations.

Design Guidance and Hierarchy

- 6.2 The PPG recommends that priority should be given to the use of Sustainable Drainage Systems (SuDS) as they are designed to control surface water run-off where it falls and mimic natural drainage characteristics as closely as possible. Sustainable drainage systems (SuDS) also provide opportunities for the following:
- reducing the causes and impacts of flooding;
 - removing pollutants from urban run-off at source; and
 - combining water management and green space with benefits for amenity, recreation and wildlife.
- 6.3 SuDS encompass a wide range of drainage techniques intended to minimise the rate of discharge, volume and environmental impact of run-off and include:
- pervious pavements;
 - swales and basins;
 - green roofs and rainwater reuse;
 - infiltration trenches and filter drains; and
 - ponds and wetlands.
- 6.4 When used across a site these techniques control the rate of discharge, attenuate flow, provide storage and improve water quality. The combination of techniques that are appropriate will be dependent upon ground conditions, topography and other site-specific characteristics.
- 6.5 The Building Regulations part H3 stipulates that rainwater from roofs and paved areas is carried away from surface to discharge to one of the following, listed in order of priority:
- a) an adequate soakaway or some other adequate infiltration system; where that is not practical;
 - b) a watercourse; or, where that is not practical;
 - c) a sewer.

Proposed Surface Water Drainage Strategy

- 6.6 The proposed strategy strives to utilise sustainable drainage techniques in accordance with guidance described in CIRIA document C753 'The SuDS Manual' (2015) to accommodate run-off from all rainfall events up to and including the 1 in 100-year event, with a 45% allowance for climate change in accordance with the latest guidance for the Hampshire Avon Management Catchment.
- 6.7 The site has impervious geology and soils, and infiltration drainage is not practical at the site. As a result, an outfall to the existing network of drainage ditches and streams surrounding the site is the preferred option in line with the drainage hierarchy.

- 6.8 A Greenfield run-off calculation for the site has been carried out in and is given in Appendix I. It can be seen that for the entire 11.05ha site the QBAR run-off rate is calculated as 62.5 l/s, which is 5.65 l/s/ha.
- 6.9 The proposed site layout does not propose to actively drain the entire site, as significant areas of naturally draining greenspace will remain within the development boundary. Figure 1 below gives a sketch showing the part of the site that will be actively drained by the proposed new drainage system following the development.

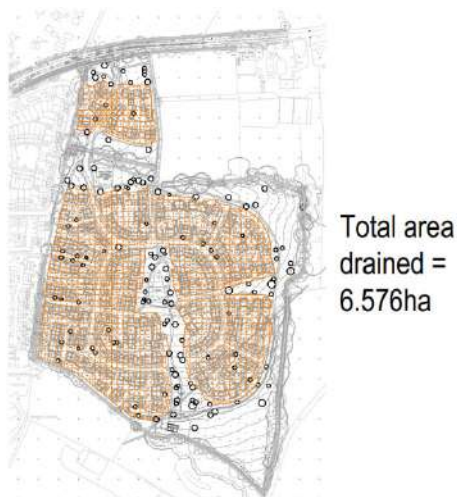


Figure 1: Area to be actively drained

- 6.10 Since the total area to be drained by the new drainage system is 6.576ha in area, the outfall rate from the new drainage system will be based on the greenfield run-off of this area only, which is 37 l/s.
- 6.11 The site layout has been developed in conjunction with the ecologist and landscape architect and allows space within the layout for a green corridor with a wide swale to convey flows towards the lowest part of the site. An attenuation basin with swale/low flow channel is incorporated into the low area at the north east corner, and a large pond is located in the south east corner of the site.
- 6.12 In general the side slopes of swales, basins, and the pond have been set at 1-in-4 to provide gentle slopes with easy access for maintenance and for escape from the basin. However, there is one area where the landscape design proposes an area of steeper bank with landscape retaining walls (gabions or similar) to provide a landscape terrace with views over the wet pond. Figure 2 shows a sketch of the area in question:

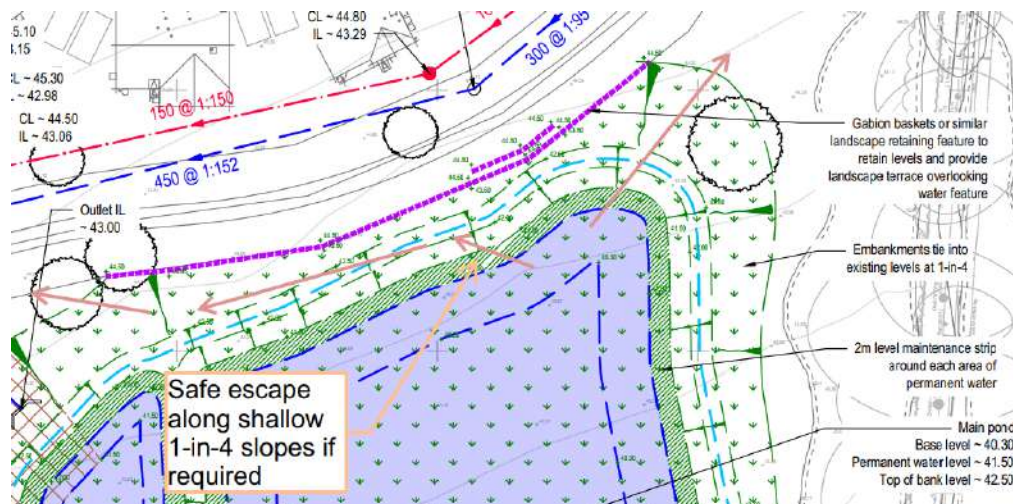


Figure 2: Extract from drainage drawing showing feature landscaping to pond bank

- 6.13 Safe escape from the basin can be provided by moving along to the end of the steep section of bank and exiting through the gentle slopes either side. The pond design provides a flat maintenance shelf just above the permanent water level that will ensure easy access. Handrails will be provided to the top of the landscape retaining walls as part of the landscape design to avoid falls.
- 6.14 The steep contours of the site mean that significant embankments are required in order to provide meaningful attenuation volumes within surface level SuDS features, and therefore geocellular crate attenuation is also proposed in order to provide supplementary attenuation, particularly within the steeper central areas of the site.
- 6.15 Permeable paving was considered for use as part of the drainage strategy for this site, but the steep slopes of the site mean that private drives will need to commonly be laid at gradients exceeding 1-in-20. Within the small area of the drives it won't be practical to install check dams and flow controls, and this leads to only a negligible storage volume for water being available. As a result, it is not considered practical to use permeable paving at this site.
- 6.16 Drawings showing the proposed drainage strategy are given in Appendix J.
- 6.17 Calculations are provided in Appendix K showing no flooding of the system in all storm events up to and including the 1-in-100 + 45% design storm event. EH 2022 has been used as the rainfall model, C_v run-off conversion factors have been set at 0.9 and 0.95 for summer and winter storms respectively, and an additional 10% has been added to all impermeable areas in order to account for the future possibility of urban creep.

Pollution Control Measures

- 6.18 The site is a residential cul-de-sac without through traffic, so as a low traffic road it is classified as a "low" risk pollution hazard level using the Simple Index Approach laid out in Chapter 26 of CIRIA C753 "The SuDS Manual". The risk indices for Total Suspended Solids (TSS), Metals, and Hydrocarbons are given as 0.5, 0.4, and 0.4 respectively.
- 6.19 Run-off at the site passes through a SuDS treatment train as it flows through the site, where run-off passes through swales basins and geocellular crates on the way down the site before reaching a large pond as the final treatment feature.

- 6.20 While geocellular crates do not innately provide pollution control measures, they are a vital part of the treatment train for this site because the provision of attenuation part way down the site in below ground crates allows flow restrictions to be placed to control the rate of run-off so that flow rates through the green swales and basins do not become excessive, ensuring that the treatment potential of these features is maximised.
- 6.21 The treatment indices of green swales and flow paths are given as 0.5 for TSS, 0.6 for Metals, and 0.6 for Hydrocarbons. The treatment indices of the pond are 0.7 for TSS, 0.7 for Metals, and 0.5 for Hydrocarbons.
- 6.22 It can be seen that either feature individually is sufficient to provide water quality treatment for run-off from this site to a level suitable to be released into the natural water environment. The majority of run-off from the site travels through both types of feature in sequence, experiencing a treatment train with overall treatment indices of 0.8 for TSS, 0.9 for Metals, and 0.8 for Hydrocarbons, almost double the required indices for a development of this type.
- 6.23 In addition to the pollution hazard indices for Total Suspended Solids, Metals, and Hydrocarbons, the site has been subject to a nutrient neutrality assessment for nitrate pollution. That assessment has been carried out by EGP. Please refer to EGP's report for further details.
- 6.24 In line with CIRIA document C815 "Using SuDS to reduce nitrogen in surface water runoff", the design has been carried out in line with the requirements of the SuDS hierarchy and to maximise the multifunctional benefits of the site open areas, with the potential nitrogen removal benefits of the scheme calculated afterwards. The guidance stresses that designers should not attempt to design "backwards" with a focus primarily on nutrient capture as this can lead to overall poor designs that fail to achieve any of the other benefits of SuDS.
- 6.25 Unfortunately in this case the steep slopes in the majority of the site mean that high retention times and significant filtration/infiltration cannot be achieved in SuDS features towards the start of the treatment train, so it is unlikely that this SuDS system will remove meaningful quantities of nitrogen from the site run-off.

Maintenance Responsibilities

- 6.26 Piped networks within adoptable roads will be offered to Southern Water for adoption as part of their network. SuDS features including ponds, basins, swales and geocellular crates will be maintained within private ownership and will be the responsibility of the site management company.
- 6.27 A maintenance schedule including typical maintenance activities for the SuDS features proposed at the site is included in Appendix L.

7.0 Summary & Conclusions

- 7.1 This report has been prepared by Glanville Consultants on behalf of Bloor Homes Southern to accompany an outline application for up to 245 dwellings (Use Class C3), up to 350sqm multi-functional space, and mobility infrastructure (Use Class Sui Generis) with associated open space, landscaping, infrastructure, and vehicular access off Mortimers Lane, Fair Oak; all matters reserved except for vehicular access off Mortimers Lane and pedestrian/cycle connections to the site boundary.
- 7.2 This assessment has been prepared in accordance with National Planning Policy Framework (NPPF), Planning Practice Guidance (PPG), flood risk and drainage guidance and with reference to Hampshire County Council (LLFA) comments.
- 7.3 The site is located entirely within Flood Zone 1, which is land at the lowest risk of fluvial flooding and is at very low risk from all other potential sources of flooding. As such, flood risk does not pose a constraint to development.
- 7.4 As infiltration is not a feasible option to manage surface water run-off from the site, a restricted discharge to the existing drainage ditch at the site boundary is proposed. Flows will be restricted to the greenfield run-off rate for all storm events up to and including the 1-in-100+45% climate change event and using the latest parameters and data.
- 7.5 The proposed SuDS design for the site provides a treatment train that is more than sufficient to treat run-off from the site and avoid potential pollution to the surrounding water environment.
- 7.6 In conclusion
- Is in accordance with the National Planning Policy Framework;
 - Will not be at an unacceptable risk from fluvial flooding or other sources;
 - Will not increase flood risk elsewhere; and
 - Will employ a surface water drainage strategy based on the principles of sustainable drainage.
- 7.7 Therefore, the proposals are considered to fully comply with National, Regional and Local planning policy in respect of flood risk and drainage.

Appendices

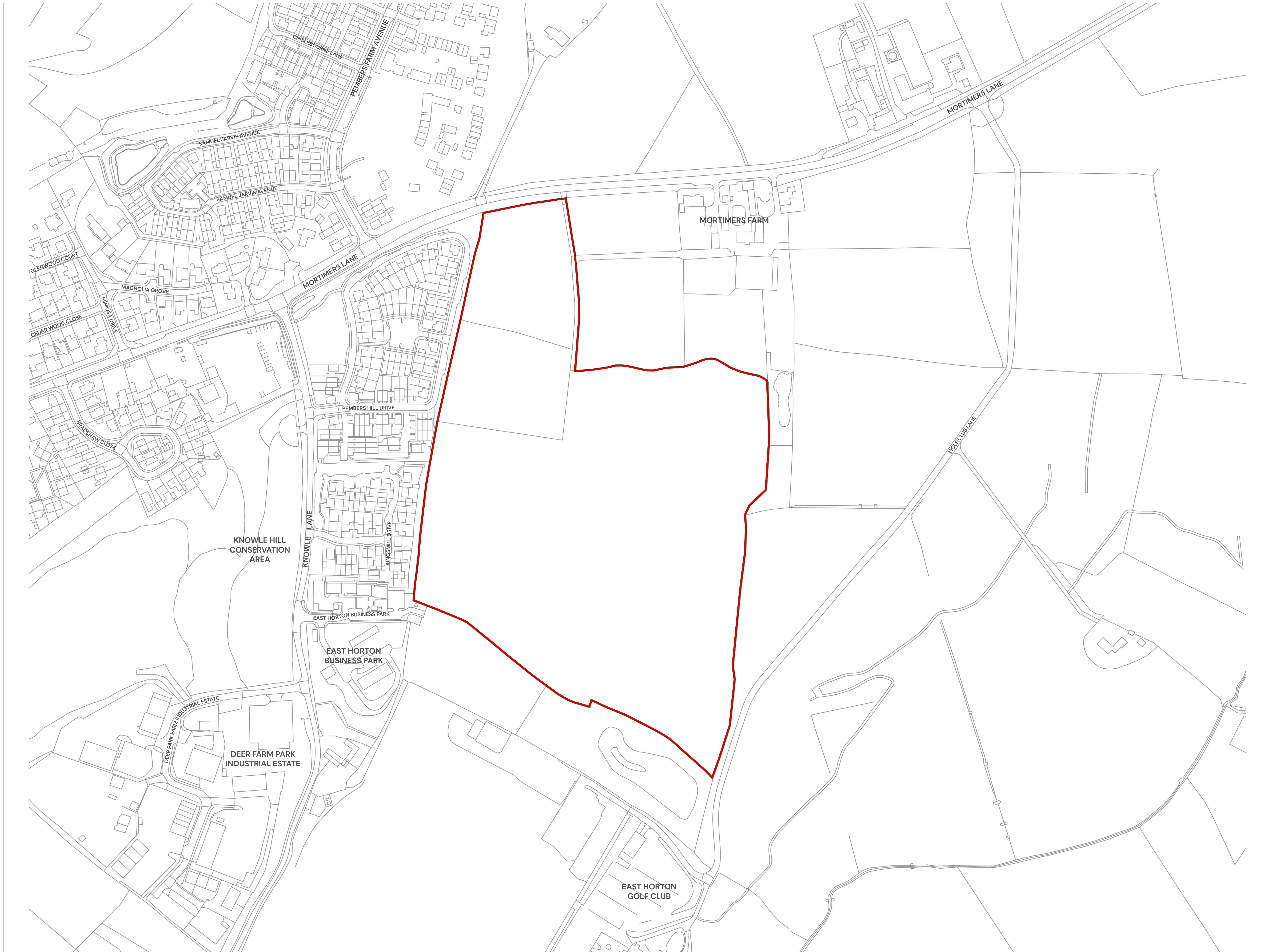




Appendix A

Location Plan

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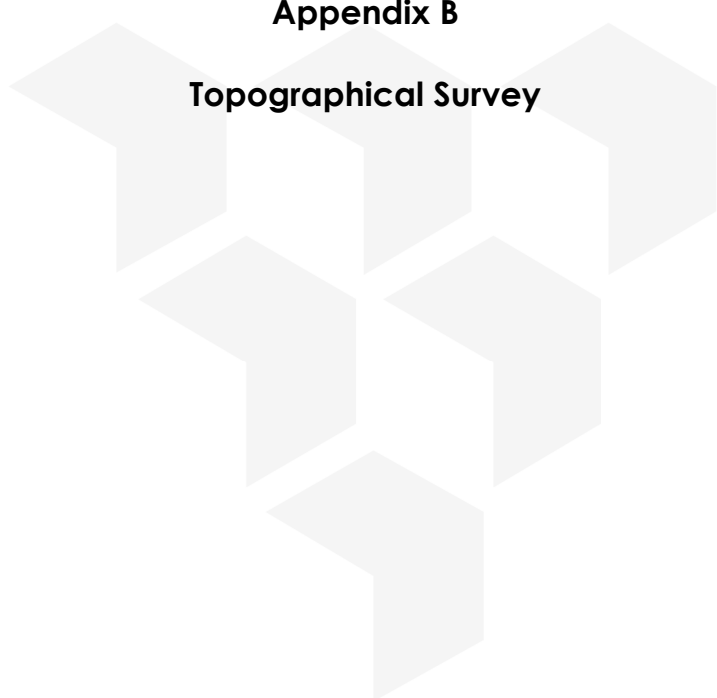
KEY

□ SITE BOUNDARY

LAND SOUTH OF MORTIMERS LANE, FAIR OAK – SITE LOCATION PLAN

PEGASUSGROUP.CO.UK | TEAM/DRAWN BY: BA | APPROVED BY P.M: TB | DATE: 15.10.24 | SCALE: 1:1250@A0 | DRWG: P23-2261_DE_002_01_REV.C | CLIENT: BLOOR HOMES





Appendix B

Topographical Survey

TREES
A AL P
B B
C C
CH Y
D D
E E
F F
G G
H H
I I
J J
K K
L L
M M
N N
O O
P P
Q Q
R R
S S
T T
U U
V V
W W
X X
Y Y

Species / Dia / Spread (max) / Ht
e.g. OK / 0.6 / 8 / 15

ABBREVIATIONS
BT British Telecom
BOL Bollard
CB Control Box
CL Cable
CTV Cable Television
E Electric
EP Electricity Pole
F Fire Hydrant
G Gas Stop Valve
H Height
HVC High Voltage Cable
IC Inspection Cover
IL Invert Level
LP Lamp Post
LH Lamp Head
MH Man-Hole
MKR Marker
MW Monitoring Well
OH Overhead
QJ Road Gully
PB Post Box
PC Pram Crossing
RNP Road Name Plate
RS Road Sign
SA Scaffolding
SV Stay / Strut
TS Telephone Box
TC Telecom
TH Trial Hole
TL Traffic Light
TP Telegraph Pole
UTL Unable to Lift
VP Vent pipe
WM Water Meter
WSV Water Stop Valve

FENCES
BWF Barbed Wire Fence
CBF Closed Board Fence
CP Concrete Post
CWF Chicken Wire Fence
IF Iron Railing Fence
PKF Picket Fence
PRF Post & Rail Fence
PMF Post & Wire Fence
SF Security Fence
SP Steel Post
WMF Wire Mesh Fence
WFF Wood Panel Fence

SURVEY STATION INFORMATION				
Name	Easting	Northing	Height	Type
P1	400001.52	118000.01	52.00	GPS
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P99	399999.54	118000.99	52.00	GPS
P100	399999.53	118001.00	52.00	GPS

SHEET 1 OF 6
SHEET 2 OF 6
SHEET 3 OF 6
SHEET 4 OF 6
SHEET 5 OF 6
SHEET 6 OF 6

NOTES
The survey grid has been related to OS National Grid using a flat earth projection and metric scale factor of 1. Levels are related to OS datum determined from the National GPS Network using OSGM15.
The position and height of adjacent buildings have been obtained using higher level reflectorless measurement and may not take account of single storey extensions or conservatories below the line of sight.

Geomatic Surveyors
Unit E, Woodside
34 Parham Drive
Eastleigh
SO50 4NU
t: 023 8081 1081
w: siteline.co.uk

BLOOR HOMES SOUTHERN Client
LAND SOUTH OF MORTIMERS LANE FAIR OAK, HAMPSHIRE Contract
SITE SURVEY Title
01MK001 (Sheet 1 of 6) Drawing Number
DECEMBER 2022 Date
1:250 (at A0) Scale
MU/BT Surveyor(s)

- TREES
- A Ash
 - AL Alder
 - AP Apple
 - B Beech
 - CB Cedar
 - CC Copper Beech
 - CH Cherry
 - CY Cypress
 - E Elm
 - EU Eucalyptus
 - FM Field Maple
 - FR Fruit
 - H Hazel
 - HC Horse Chestnut
 - HO Holm Oak
 - HW Hawthorn
 - JM Japanese Maple
 - LB Laburnum
 - LM Lime
 - LO Locust Tree
 - LR Laurel
 - MA Maple
 - MG Magnolia
 - OK Oak
 - PL Pine
 - PM Plum
 - PO Poplar
 - PP Pissardi Plum
 - PR Pear
 - RD Redwood
 - RO Red Oak
 - RR Rhododendron
 - RS Rowan
 - SC Silver Birch
 - SC Sweet Chestnut
 - SC Scots Pine
 - SP Spruce
 - SY Sycamore
 - UN Unidentified
 - W Willow
 - WN Walnut
 - Y Yew

Species / Dia / Spread (max) / Ht
e.g. OK / 0.6 / 8 / 15

- ABBREVIATIONS
- BT British Telecom
 - BOL Bollard
 - CB Control Box
 - CL Cover Level
 - CTV Cable Television
 - EP Electric Pole
 - EP Fire Hydrant
 - FS Gas Stop Valve
 - GS Gas Stop Valve
 - HVC High Voltage Cable
 - IC Invert Level
 - IL Lamp Post
 - LP Lamp Post
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 - MKR Marker
 - MW Monitoring Well
 - OIH Overhead
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- SHEET 1 OF 6
- SHEET 2 OF 6
- SHEET 3 OF 6
- SHEET 4 OF 6
- SHEET 5 OF 6
- SHEET 6 OF 6



NOTES

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SURVEY STATION INFORMATION				
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P3	400000.000	100000.000	20.000	NAVL
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P6	400000.000	100000.000	20.000	NAVL
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P30	400000.000	100000.000	20.000	NAVL
P31	400000.000	100000.000	20.000	NAVL
P32	400000.000	100000.000	20.000	NAVL

Geomatic Surveyors

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w: [siteline.co.uk](http://www.siteline.co.uk)

BLOOR HOMES SOUTHERN Client

LAND SOUTH OF
MORTIMERS LANE
FAIR OAK, HAMPSHIRE Contract

SITE SURVEY Title

01MK001 (Sheet 3 of 6) Drawing Number

DECEMBER 2022 Date

1:250 (at A0) Scale

MJ/ST Surveyor(s)

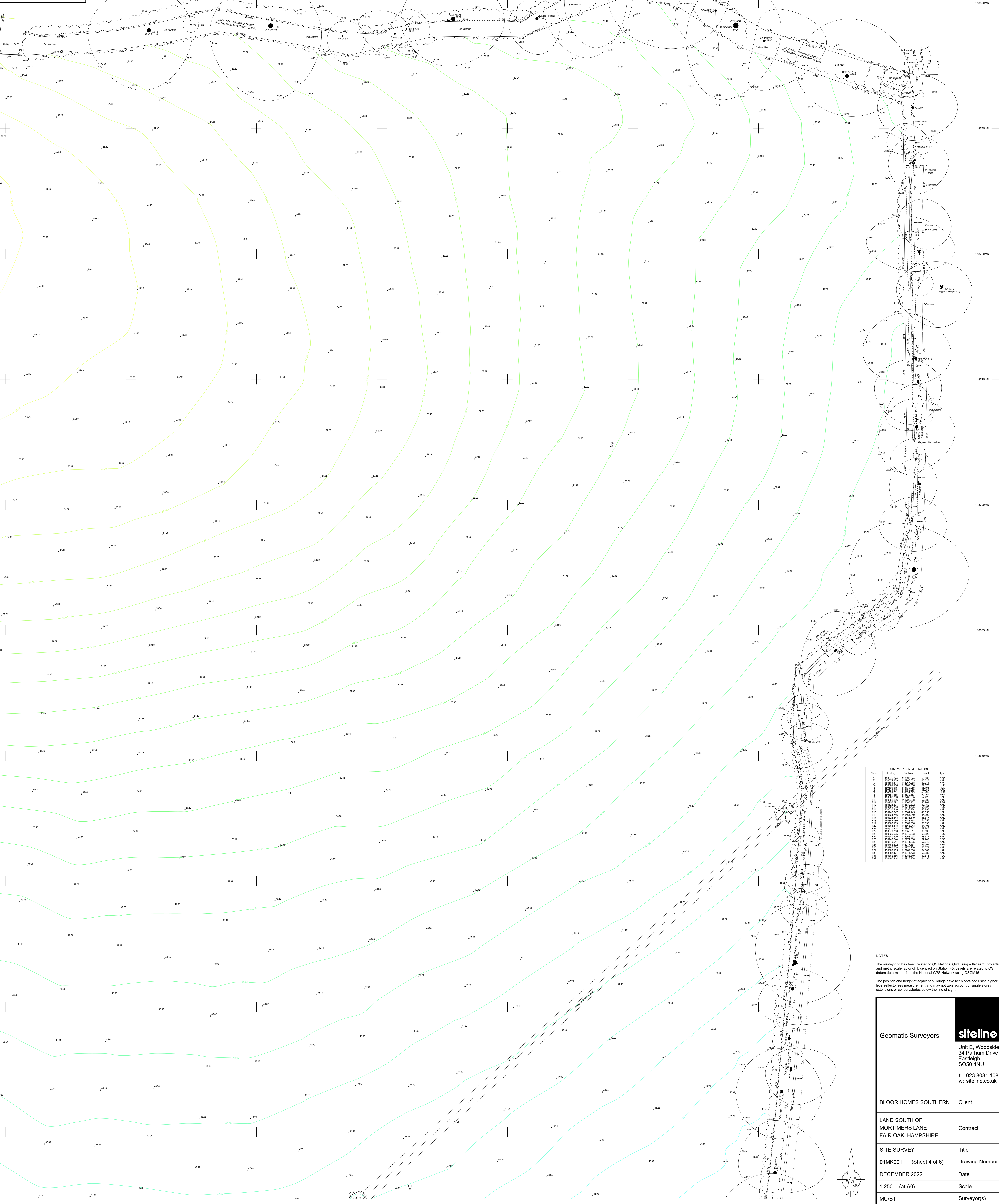
- TREES
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 - AL Alder
 - AP Apple
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 - MO Pine
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Species / Dia / Spread (max) / Ht
e.g. OK / 0.6 / 8 / 15

SHEET 1 OF 6
SHEET 2 OF 6
SHEET 3 OF 6
SHEET 4 OF 6
SHEET 5 OF 6
SHEET 6 OF 6



SURVEY STATION INFORMATION				
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F7	400010.124	110000.874	20.000	REF
F8	400010.124	110000.874	20.000	REF
F9	400010.124	110000.874	20.000	REF
F10	400010.124	110000.874	20.000	REF
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F32	400010.124	110000.874	20.000	REF

NOTES

The survey grid has been related to OS National Grid using a flat earth projection and metric scale factor of 1, centred on Station F5. Levels are related to OS datum determined from the National GPS Network using COSMOS.

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Geomatic Surveys

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BLOOR HOMES SOUTHERN	Client
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SITE SURVEY	Title
01MK001 (Sheet 4 of 6)	Drawing Number
DECEMBER 2022	Date
1:250 (at A0)	Scale
MJ/BT	Surveyor(s)

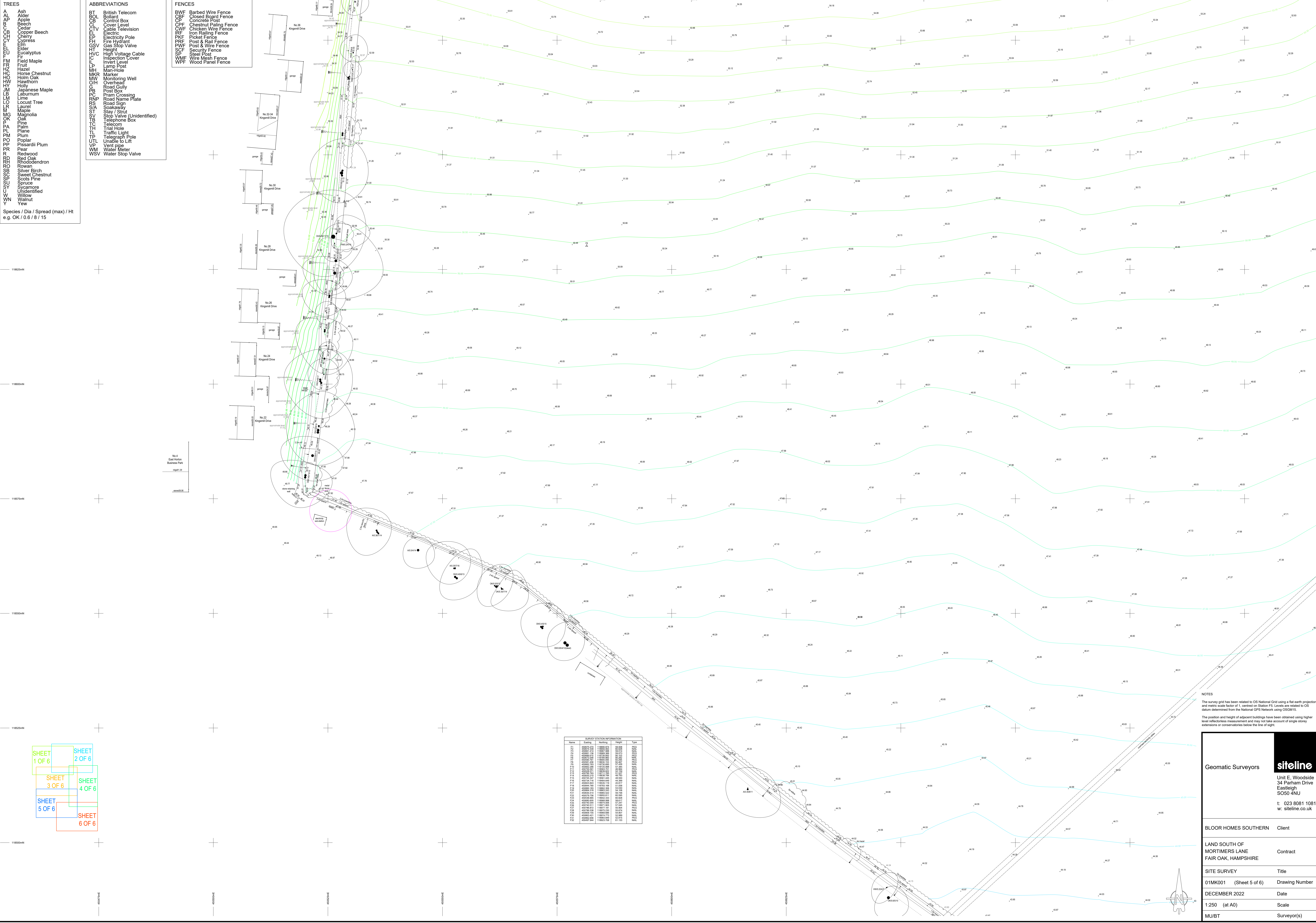
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B BOL
C CB
CH CH
CO CO
CU CU
F F
H H
J J
L L
M M
O O
P P
R R
S S
T T
U U
V V
W W
Y Y

Ash
Alder
Apple
Beech
Cedar
Copper Beech
Cherry
Cypress
Elder
Eucaalyptus
Fir
Field Maple
Fruit
Hazel
Horse Chestnut
Horn Oak
Hawthorn
Holly
Japanese Maple
Laburnum
Lime
Locust Tree
Laurel
Maple
Magnolia
Oak
Palm
Plane
Plum
Poplar
Pissardi Plum
Pine
Redwood
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SURVEY STATION INFORMATION				
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1.2	118000.00	118000.00	118000.00	PC
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1.4	118000.00	118000.00	118000.00	PC
1.5	118000.00	118000.00	118000.00	PC
1.6	118000.00	118000.00	118000.00	PC
1.7	118000.00	118000.00	118000.00	PC
1.8	118000.00	118000.00	118000.00	PC
1.9	118000.00	118000.00	118000.00	PC
2.0	118000.00	118000.00	118000.00	PC
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9.9	118000.00	118000.00	118000.00	PC
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NOTES
The survey grid has been related to OS National Grid using a flat earth projection and metric scale factor of 1. continued on Station FS. Levels are related to OS datum determined from the National GPS Network using OSGM15.
The position and height of adjacent buildings have been obtained using higher level reflectorless measurement and may not take account of single storey extensions or conservatories below the line of sight.

SHEET 1 OF 6
SHEET 2 OF 6
SHEET 3 OF 6
SHEET 4 OF 6
SHEET 5 OF 6
SHEET 6 OF 6

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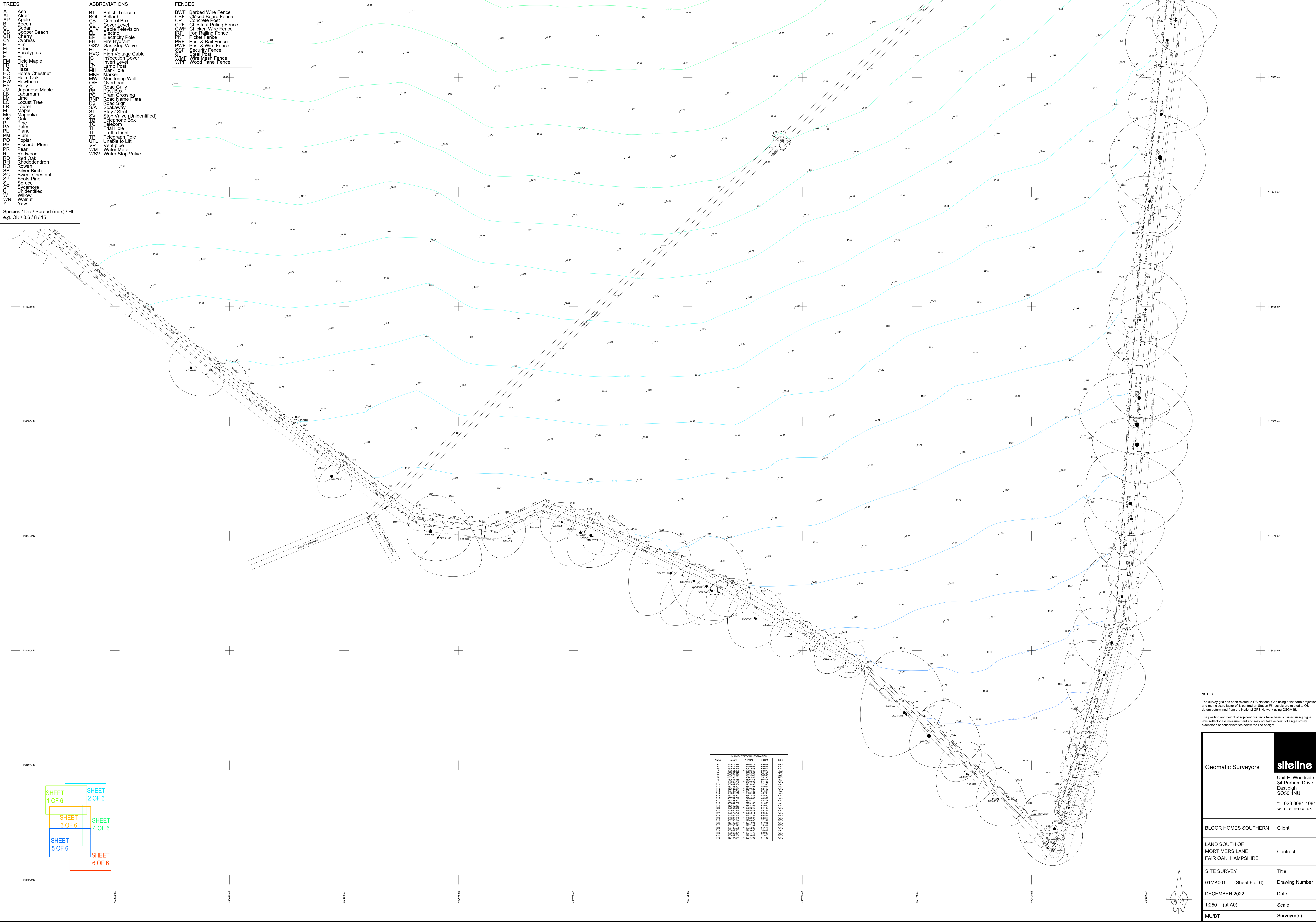
BLOOR HOMES SOUTHERN Client
LAND SOUTH OF MORTIMERS LANE FAIR OAK, HAMPSHIRE Contract
SITE SURVEY Title
01MK001 (Sheet 5 of 6) Drawing Number
DECEMBER 2022 Date
1:250 (at A0) Scale
MU/ST Surveyor(s)

- TREES
- AL Ash
 - AP Alder
 - BB Beech
 - CB Cedar
 - CH Cherry
 - CO Cypress
 - CU Elm
 - EU Eucalyptus
 - FM Field Maple
 - FR Fruit
 - HA Hazel
 - HC Horse Chestnut
 - HO Holm Oak
 - HW Hawthorn
 - HY Holly
 - JM Japanese Maple
 - LB Laburnum
 - LM Lime
 - LO Locust Tree
 - LR Laurel
 - MA Maple
 - MG Magnolia
 - OK Oak
 - PA Palm
 - PL Plane
 - PM Plum
 - PO Poplar
 - PP Pissardi Plum
 - PR Pear
 - RD Redwood
 - RO Red Oak
 - RS Rhododendron
 - SA Silver Birch
 - SC Sweet Chestnut
 - SP Scots Pine
 - SR Spruce
 - SY Sycamore
 - UN Unidentified
 - WI Willow
 - WN Walnut
 - YW Yew

Species / Dia / Spread (max) / Ht
e.g. OK 0.6 / 8 / 15

- ABBREVIATIONS
- BT British Telecom
 - BOL Bollard
 - CB Control Box
 - CL Cover Level
 - CTV Cable Television
 - EP Electric Pole
 - EP Fire Hydrant
 - GSV Gas Stop Valve
 - HVC Height
 - IC Inspection Cover
 - IL Invert Level
 - LP Lamp Post
 - LP Man-Hole
 - MR Marker
 - MW Monitoring Well
 - OH Overhead
 - OS Road Sign
 - PC Pram Crossing
 - RNP Road Name Plate
 - RS Road Sign
 - SA Skewway
 - SV Stop Valve (Unidentified)
 - TS Telephone Box
 - TC Telecom
 - TH Trial Hole
 - TL Traffic Light
 - UTL Telegraph Pole
 - VP Unable to Lift
 - VM Vent pipe
 - WM Water Meter
 - WSV Water Stop Valve

- FENCES
- BWF Barbed Wire Fence
 - CBF Closed Board Fence
 - CP Concrete Post
 - CPF Chestnut Piling Fence
 - CWF Chicken Wire Fence
 - IRF Iron Railing Fence
 - PKF Picket Fence
 - PRF Post & Rail Fence
 - PMF Post & Wire Fence
 - SCF Security Fence
 - SP Steel Post
 - WMF Wire Mesh Fence
 - WPF Wood Panel Fence



SURVEY STATION INFORMATION				
Name	Eastings	Northing	Height	Type
F10	485712.541	118501.445	40.000	NAIL
F11	485712.740	118504.860	40.000	NAIL
F12	485712.939	118508.275	40.000	NAIL
F13	485713.138	118511.690	40.000	NAIL
F14	485713.337	118515.105	40.000	NAIL
F15	485713.536	118518.520	40.000	NAIL
F16	485713.735	118521.935	40.000	NAIL
F17	485713.934	118525.350	40.000	NAIL
F18	485714.133	118528.765	40.000	NAIL
F19	485714.332	118532.180	40.000	NAIL
F20	485714.531	118535.595	40.000	NAIL
F21	485714.730	118539.010	40.000	NAIL
F22	485714.929	118542.425	40.000	NAIL
F23	485715.128	118545.840	40.000	NAIL
F24	485715.327	118549.255	40.000	NAIL
F25	485715.526	118552.670	40.000	NAIL
F26	485715.725	118556.085	40.000	NAIL
F27	485715.924	118559.500	40.000	NAIL
F28	485716.123	118562.915	40.000	NAIL
F29	485716.322	118566.330	40.000	NAIL
F30	485716.521	118569.745	40.000	NAIL
F31	485716.720	118573.160	40.000	NAIL
F32	485716.919	118576.575	40.000	NAIL

NOTES

The survey grid has been related to OS National Grid using a flat earth projection and metric scale factor of 1. Contours on Station TS Levels are related to OS datum determined from the National GPS Network using OSGM15.

The position and height of adjacent buildings have been obtained using higher level reflectorless measurement and may not take account of single storey extensions or conservatories below the line of sight.

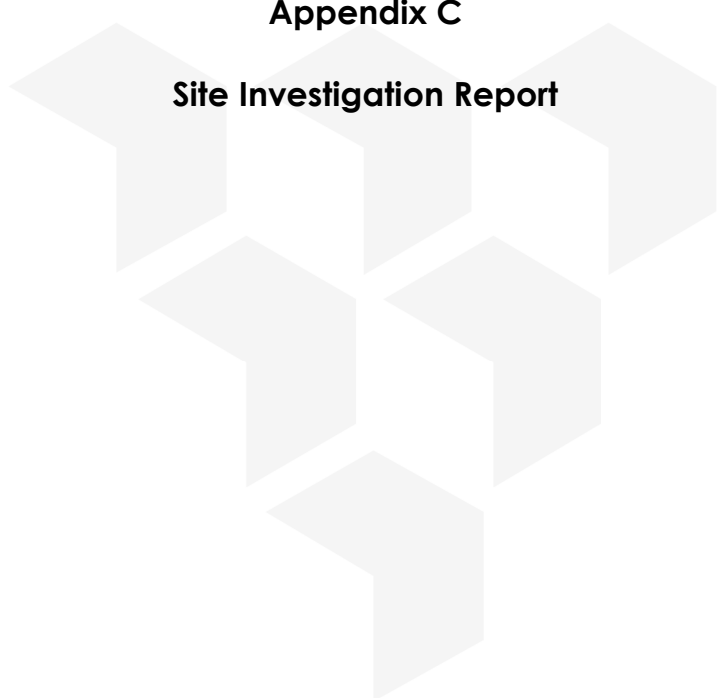
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BLOOR HOMES SOUTHERN	Client
LAND SOUTH OF MORTIMERS LANE FAIR OAK, HAMPSHIRE	Contract
SITE SURVEY	Title
01MK001 (Sheet 6 of 6)	Drawing Number
DECEMBER 2022	Date
1:250 (at A0)	Scale
MJ/ST	Surveyor(s)



Appendix C

Site Investigation Report



Geo-Environmental

GROUND INVESTIGATION REPORT
for the land at
LAND SOUTH OF MORTIMERS LANE,
FAIR OAK, HAMPSHIRE,
SO50 7HN
on behalf of
BLOOR HOMES SOUTHERN

Ground Investigation Report

Report:	GROUND INVESTIGATION REPORT
Site:	LAND SOUTH OF MORTIMERS LANE, FAIR OAK, HAMPSHIRE, SO50 7HN
Client:	BLOOR HOMES SOUTHERN
Date:	01/09/2023
Reference:	GE21215-GIRv2-SEP23
Version:	2.0
Prepared by:	
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Reviewed by:	
	SHAUN ARMITAGE BSc (Hons), FGS PRINCIPAL ENGINEER
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AMENDMENT RECORD

Revision ref.	Date	Reasons for amendment	Author's initials	Reviewed by	Approved by
1.0	28/04/2023	First Issue	FG	SA	LL
2.0	01/09/2023	Update to include additional gas monitoring results	FG	LL	LL

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FIGURES

FIGURE 1	Site Location Plan
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APPENDICES

APPENDIX A	Site Photographs
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EXECUTIVE SUMMARY		
Site Details	Site Address	Land South of Mortimers Lane, Fair Oak, Hampshire, SO50 7HN
	National Grid Reference	450686, 118681
	Site Area	11.29Ha (approx.)
	Form of Development	The proposed development is understood to comprise the construction of residential dwellings with associated private gardens, areas of soft landscaping, car parking, access road and other associated development infrastructure.
Encountered Conditions	Scope of works	An intrusive investigation was required to confirm the ground and groundwater conditions and to support the development of a ground gas risk assessments pertaining to the site in relation to the proposed development.
	Ground Conditions	The ground conditions encountered within the exploratory holes undertaken were broadly consistent with those anticipated, i.e. a thickness Topsoil overlying London Clay Formation. Soils of the Whitecliff Sand Member were not encountered during the intrusive investigation works undertaken.
	Groundwater	Groundwater was encountered within boreholes, WS01, WS02, WS03, WS08 and WS11 (5No. of the 12No. positions undertaken) during the intrusive investigation works undertaken, between depths of 2.00m and 4.00m bgl (44.23 to 50.80m AOD). Groundwater monitoring wells were installed within window sampler boreholes WS01-WS12 at depths between 3.00m and 5.00m bgl to provide coverage across the site. Thirteen return spot groundwater monitoring rounds (with gas recorded on 12 of the visits) have been completed between December 2022 and August 2023, with groundwater encountered between depths of 0.01m bgl and 4.01m bgl prior to any bailing/purging and between 0.05m and 4.15m bgl following recovery after bailing/purging of the wells was completed, with water being recorded at surface level within WS08 and WS10 on a couple of occasions in January and February 2023.
Gas Assessment	Radon Gas	No radon protection measures are required.
	Ground Gases	It is considered, based on the site conceptual model and monitoring undertaken to date that gases are not migrating from the nearby former landfill sites, that only diffusive flow conditions are present beneath the site, and that only low-risk sources of bulk gases are actually present on the subject site, due to the biological respiration within the underlying natural geology (London Clay Formation). In addition, it is also considered that should the active gas collector system present on Fair Oak Landfill site fail or be switched off, any gas would migrate via more preferential pathways based on underlying permeable soils, groundwater flow direction and topography in a south westerly direction away from the subject site. Based on the gas risk assessment the site's gassing regime, based on both hazardous gas flow and limiting concentrations, is classified as Characteristic Situation 1 (CIRIA and BS) and Green (NHBC) for which gas protection measures would not be required.
Further Action: - When development proposals have been decided, undertake further intrusive investigation works to enable geotechnical assessment and soil contamination assessments to be undertaken to support proposed development; - A discovery strategy must be maintained during development such that any abnormal conditions (geotechnical or potential contamination) are identified, the discovery strategy should be enacted and their potential impact on the proposed development assessed prior to determining any potential mitigation measures.		
<i>This Executive Summary is intended to provide a brief summary of the main findings and conclusions of the investigation.</i>		

EXECUTIVE SUMMARY

For detailed information, the reader is referred to the main report ref. GE21215-GIRv2-SEP23.

1.0 INTRODUCTION

1.1 General

Geo-Environmental Services Limited, (Geo-Environmental) was instructed by Bloor Homes Southern, (the Client), to undertake an investigation of the ground gas risks pertaining to the proposed development at Land South of Mortimers Lane, Fair Oak, Hampshire, SO50 7HN (herein referred to as 'the site'). The site's location is presented in Figure 1.

A Standalone Desk Study Report, reference GE21215/DSR/FEB23, was previously prepared by Geo-Environmental for the site. Subsequent to the findings of the desk study and preliminary risk assessment, an intrusive Phase II investigation was undertaken into the ground gas conditions pertaining to the site and its redevelopment.

1.2 Form of Development

The proposed development is understood to comprise the construction of residential dwellings with associated private gardens, areas of soft landscaping, car parking, access road and other associated development infrastructure.

1.3 Objectives

The investigation was to comprise an intrusive investigation undertaken into the geo-environmental ground gas conditions pertaining to the site.

The objective of the investigation and subsequent assessments was to evaluate the risks posed to the proposed redevelopment, adjacent land uses and the wider environment, in the context of likely planning requirements, immediate liabilities under the Environmental Protection Act 1990 and risks posed to Controlled Waters under the Water Resources Act from the current status of the site and in line with the current redevelopment in relation to ground gas.

1.4 Standards and References

Where practicable, the ground investigation and subsequent environmental assessments were undertaken in accordance with the following documents and guidance.

- National Planning Policy Framework, July 2021;
- Land Contamination Risk Management (LCRM), updated July 2023;
- Model Procedures for the Management of Contaminated Land, CLR11, DEFRA and Environment Agency 2004 (withdrawn);
- Environment Agency Guidance on Requirements for Land Contamination Reports, Version 1 dated July 2005;
- BS10175:2011+A2:2017 - Investigation of Potentially Contaminated Sites - Code of Practice, BSI 2017;
- BS5930:2015+A1:2020 - Code of Practice for Site Investigations, BSI 2020;
- CIRIA C665 – Assessing risks posed by hazardous ground gases to buildings (2007);
- NHBC 10627-R01(04)- Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present (2007);
- BS8485:2015+A1:2019 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.



1.5 Conditions

This report does not purport to be a “Geotechnical Design Report” as defined in Clause 2.8 of Eurocode 7 (Geotechnical Design BS EN 1997-1:2004) and some of the data used to support this preliminary geotechnical assessment may not be fully compliant with that design code. It is considered possible that further detailed ground investigations could be required to facilitate the detailed geotechnical design process and should be carried out on a structure specific basis if necessary.

The desk study data where obtained/reviewed for the site or where presented as part of third party reports is assumed to be factually correct and up to date at the point of purchase. No liability is taken for any omissions or inaccuracies in the data presented. It must also be noted that changes to the desk study data may occur following the production of this report, Geo-Environmental accepts no liability where this subsequently affects the assessment presented herein.

The data collected from the investigations have been used to provide an interpretation of the geotechnical and/or environmental conditions pertaining to the site. The recommendations and opinions expressed in this report are based on the data obtained. Geo-Environmental takes no responsibility for conditions that either have not been revealed in the available records, or that occur between or under points of physical investigation, or that result from updates to desk based data/third party investigations utilised subsequent to that presented herein or reviewed at the time of writing which may in turn alter the presented assessment. Whilst every effort has been made to interpret the conditions, such information is only indicative and liability cannot be accepted for its accuracy.

It must be noted that the findings and assessment presented herein are based on the ground and groundwater conditions as encountered at the time of investigation within the investigation positions undertaken and any associated testing and monitoring. The ground by its very nature is variable and the engineering properties of soils can vary over time, such as due to changes in soil moisture content, disturbance and similar factors. Similarly, groundwater conditions can and do vary over time. As such, if conditions are encountered which differ from those described herein, the Client or their appointed representative, e.g. contractor, must seek advice from a Geotechnical Engineer at the earliest practicable opportunity. It is possible that this could result in changes to the assessment presented herein.

It should be noted that in particular the concentrations and levels of mobile liquid and gaseous materials are likely to vary with time. The results obtained may therefore only be representative of the conditions at the time of sampling. The absence of asbestos noted during the site walkover or within any soil samples analysed does not guarantee the absence of asbestos within buildings, within or bonded to concrete, as discrete burials, or within the soils mass elsewhere within a site. This report should not be taken as any guarantee that a site is free of hazardous or potentially contaminative materials.

Information contained in this report is intended for the use of the Client and Geo-Environmental can take no responsibility for the use of this information by any party for uses other than that described in this report. Geo-Environmental makes no warranty or representation whatsoever express or implied with respect to the use of this information by any third party. Geo-Environmental does not indemnify the Client or any third parties against any dispute or claim arising from any finding or other result of this investigation report or any consequential losses.

Assessment criteria or other parameters developed for the evaluation of contamination on this site are based on a number of assumptions regarding exposure and toxicology. Exposure to contaminants and levels of adverse effects may therefore vary. Whilst reasonable care and expertise has been employed in the development of such criteria, no liability is accepted in this respect. Other criteria or guidance on the development of assessment criteria may be published in the future and no liability is accepted in this respect.

This report remains the property of Geo-Environmental and the Client has no rights to, or reliance upon this document or supporting documents until such time as payment has been received in full for all invoices for works undertaken in connection with this report.

2.0 SITE CONTEXT

2.1 Site Description

The site comprised an irregularly shaped parcel of land which extended to c.11.29Ha and was located at NGR 450686, 118681. A detailed site walkover survey was undertaken on 15th December 2022 and presented within the desk study report (GE21215/DSR/FEB23), the key details of which are included herein. Photographs taken during the site walkover survey are presented in Appendix A.

The site was accessed from the north via a gateway secured with a steel bar gate located off Mortimers Lane. A grassed farm track ran from this access way into the site providing access to the three fields and adjacent fields outside of the site boundary. The track was laid to grass with track marks and sloped gently upwards at first then sloped away to the south down towards the southern field.

The northern field was roughly square shaped and laid to grass. An access farm track was located to the east of this field. The field sloped gently down to the southwest and was bounded by fencing along all boundaries with mixed hedgerows and trees along the northern, southern and western boundaries.

A small field was located to the south of the northern field, was laid to grass and was mainly flat and level. The field was fenced along all boundaries with a hedgerow and trees located along the northern and western boundaries.

The southern field made up the majority of the site and was laid to grass. The field sloped away to the south with the lowest point of the site along the southern boundary. This low southern portion of the site was noted to be wet under foot during the walkover survey. A drainage ditch was also noted to be present along this southern boundary located outside of the site. Overhead electrical cables were located in the south-eastern portion of the field running in a northeast to southwest direction. The southern field was bounded by fencing on all boundaries along with hedgerows and trees along the eastern, southern and western boundaries.

The site was bounded by residential properties to the west, Mortimers Lane with fields beyond to the north, agricultural fields to the east and commercial uses (storage yard and data centre) and a former landfill site to the south. This former landfill site was observed to have an active gas extraction system located approximately 60m south of the southern site boundary.

2.2 Geology

British Geological Survey (BGS) geological mapping indicated the geology underlying the site to comprise the bedrock geology of the London Clay Formation across the majority of the site with an outcrop of the Whitecliff Sand Member across the central western portion of the site. In addition, there is a possibility that limited areas of the site, most likely limited to the current track access to the site, may comprise a mantle of Made Ground overlying these natural strata. Made Ground/infilled ground is also understood to be present to the south of the site due to the presence of a former landfill site.

BS5930:2015 defines **Made Ground** as anthropogenic ground in which the material has been placed without engineering control and/or manufactured by man in some way, such as through crushing or washing, or arising from an industrial process. Great variations in material type, thickness and degree of compaction invariably occur and there can be deleterious or harmful matter, as well as potentially methanogenic organic material. In addition, on sites which have undergone several phases of historic development it is not uncommon for asbestos to be present at surface and within Made Ground and/or disturbed soils.

Within the south Hampshire and Solent region, the **London Clay Formation** consists predominantly of silty clay, sandy clay and silty sand, sporadic claystones occur and thin but persistent bands of rounded flint pebbles occur at the bases of sedimentary cycles. Lenticular bodies of sand such as the **Whitecliff Sand** and Portsmouth Sand fill channels in the upper parts of the formation.

2.3 Hydrogeology

The underlying bedrock strata were classified as a Secondary 'A' aquifer (Whitecliff Sand) and Unproductive Strata (London Clay).

Secondary 'A' aquifers are defined as, permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

Unproductive Strata are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The site is not shown to be located within a Groundwater Source Protection Zone (SPZ).

The site was identified as being located within an area with limited potential of groundwater flooding to occur. The Whitecliff Sand is considered likely to have a higher permeability than the surrounding strata of the London Clay Formation. It is also possible that infiltrating water could become perched within the Whitecliff Sand and sandier strata where constrained by less permeable strata, such that a single groundwater body within the London Clay Formation is unlikely.

The nearest surface water feature which comprised a pond which was located c.5m east of the site.

2.4 Radon

The Envirocheck report states that the site lies in an area where <1% of homes are above the Action Level as defined by Public Health England and the BGS. In addition, the BGS assessment states that no radon protective measures are required in the construction of new houses or extensions on the site.



3.0 PRELIMINARY RISK ASSESSMENT SUMMARY

The Preliminary Risk Assessment (PRA) and Conceptual Site Model (CSM) developed from the information gathered as part of the desk study (ref. GE21215/DSR/FEB23) process identified plausible potential pollutant linkages that exist in relation to the proposed residential redevelopment of the site. However, the preliminary risk rating for each potential linkage identified ranged from moderate, moderate/low to very low with a moderate risk assigned in relation to ground gases.

The potential pollutant linkages established within the desk study were not considered to prevent development on the subject site, but were considered to require investigation and assessment to support further characterisation, calibration of the CSM and where/if necessary, determine a remedial strategy to reduce, remove or otherwise control any risk within the site to key receptors.

In order to progress the assessment in line with best practice guidance and to provide further characterisation of the site and refinement of the PRA and CSM, it was recommended that an intrusive investigation and associated testing was to be undertaken to confirm the findings of the desk study report and to provide a robust risk assessment for the site and proposed redevelopment. As such, it was recommended that a geochemical and geotechnical investigation be carried out on the site to include analysis of soil and groundwater (if encountered) samples for the range of potential contaminants identified within the desk study. A period of ground gas monitoring and associated ground gas risk assessment was also recommended.

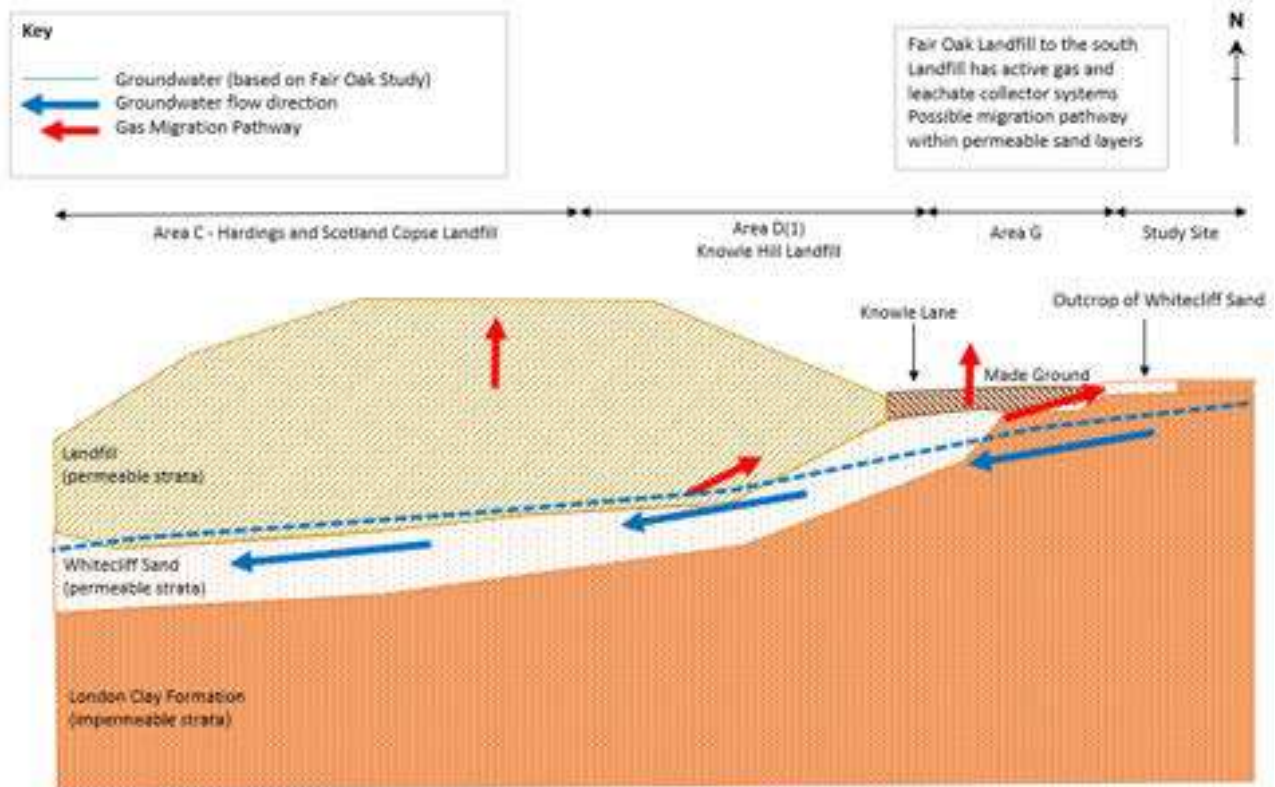
3.1 Ground Gas and Vapour Summary

The desk study identified the potential for ground gases and vapours associated with four nearby former landfill sites located to the south and west of the site. These landfill sites are considered to represent a potential source of ground gas due to the types of wastes that were permitted and deposited within these offsite landfills.

There is active landfill gas collection and leachate management at Fair Oak Landfill site located immediately to the south of the site. There are gas and groundwater monitoring boreholes located around the perimeter of the landfill site, including along the northern boundary, the boundary of the landfill closest to the subject site. The boreholes are understood to be monitored routinely for the presence of landfill gases and the results are reported to the Environment Agency in line with the landfill sites Environmental Permit. It is understood that there are no gas collection systems in place within the other three former landfill sites identified in the vicinity of the site, Knowle Lane (c.77m southwest), Knowle Hill Lane (c.107m west), and Hardings and Scotland Copse (c.184m west).

The anticipated geology underlying the site comprises no superficial deposits, but bedrock geology primarily of the London Clay Formation with an outcrop of Whitecliff Sand Formation running across the central western portion of the site. The underlying London Clay bedrock geology is primarily formed of impermeable clay layers and as such is unlikely to represent a plausible migration pathway for ground gases. However, the outcrop of Whitecliff Sand strata forms a roughly horizontally bedded formation which is likely to contain permeable layers that could represent a plausible lateral migration pathway. Lateral permeability in the Whitecliff Sand strata is likely to be substantially greater than vertical permeability.

The four nearby former landfills sites are assumed to be located within the Whitecliff Sand Formation. In addition, the Fair Oak Landfill study undertaken by Card on behalf of Eastleigh Borough Council in April 2012, identified a possible preferential pathway in Area G (adjacent to the southwest of the site) running south-north towards the subject site potentially influenced by the geological change from the Whitecliff Sand to the London Clay. Therefore, as the Whitecliff Sand is shown on geological mapping to outcrop on part of the subject site, some form of plausible gas migration pathway from the landfills to the subject site should be assumed as being likely to be present (the intrusive investigation looked to target this potential outcrop). A conceptual site model for ground gas in the vicinity of the subject site and adjacent Fair Oak Landfill site is in Cross Section 1 presented below:



Cross Section 1 – Conceptual Site Model – Ground Gas

Geo-Environmental is aware of development related works on the northern portion of Area G to the west and south west of the subject site. These works are understood to have comprised the stripping of overburden soils from a former sand pit, winning of additional sand (Whitecliff Sand) and subsequent backfilling with the stripped overburden and imported soils. The backfill was understood to comprise clay rich soils. It is anticipated that the full depth of Whitecliff Sand was not won, but possibly excavated to a practicable cut-off defined by encountered groundwater levels. The excavation of sand strata and backfilling with clay rich materials may, to some degree, serve to isolate the remnant Whitecliff Sand Member below the subject site from the chain of landfills downgradient to the south and west.

Ground gas monitoring was recommended to assess whether landfill gases are migrating to the site from the nearby former landfills. It was recommended that 'spot' monitoring was undertaken in order to appropriately assess the risks from ground gases and to target a worst case scenario, so as to be in line with current good practice.

4.0 GROUND INVESTIGATION

4.1 Scope of Works

The scope of the works undertaken at the site to date comprised:

- Attendance of a specialist surveyor to undertake a buried utilities clearance survey of the proposed exploratory hole locations using radio-detection and ground penetrating radar techniques. The survey included capture of co-ordinates and levels of exploratory holes using GPS surveying where possible. It should be noted that it was not possible to obtain levels from WS05 and WS11, due to the GPS being unable to lock onto their positions.
- Construction of 12No. dynamic sampler boreholes (WS01-WS12) to depths of up to 5.00m bgl.
- Installation of 12No. groundwater and gas monitoring wells to depths of between 3.00 and 5.00m bgl
- Return winter groundwater monitoring on a monthly basis between December 2022 and April 2023.
- Return spot gas monitoring on six occasions between December 2022 and March 2023.
- Additional return spot gas and groundwater monitoring on six occasions between June and August 2023 at roughly fortnightly intervals.
- Geochemical laboratory testing for Total Organic Carbon in recovered soil samples.

4.2 Investigation Strategy

The positioning of exploratory holes was determined on site to provide general coverage and to target specific areas whilst working within access restrictions associated with current site uses. Table 4.1 sets out the investigation strategy adopted.

Area of Concern	Investigation	Positions
General ground conditions	Exploratory holes located across the site, coupled with sampling and laboratory analysis.	All
General gassing regime and groundwater levels across site	Spot monitoring within wells located across the site.	All
Adjacent landfill to the south of the site	Spot monitoring within wells located in the south of the site.	WS10, WS11, WS12
Geological variation in underlying strata	Spot monitoring within wells located in the central portion of the site, where geological variation mapped.	WS03, WS04, WS06

Table 4.1 Summary of the Investigation Strategy

Soil samples were collected and placed into tubs and cool boxes on site for transit to the office, where they were stored under chilled conditions (<4°C) prior to final transportation in cool boxes to the laboratory by their in-house courier. The total organic carbon testing was undertaken by UKAS accredited laboratories (where appropriate). Samples were stored in temperature controlled conditions from sampling until receipt at the laboratory from which time sample preparation and storage was determined by testing requirements and in line with laboratory's protocols.

5.0 ENCOUNTERED CONDITIONS

A factual record of the conditions encountered during the physical preliminary investigation of the site is presented in the following sections.

For further details of the ground conditions, reference should be made to the exploratory hole logs and in situ testing presented in Appendix B, geochemical testing results presented in Appendix C, and groundwater and gas monitoring results presented in in Appendix D.

The physical ground investigation works were undertaken on 15th and 16th December 2022.

Unless stated otherwise, all depths are reported as metres below ground level (m bgl).

5.1 Soils

With reference to British Geological Survey (BGS) mapping the geology of the site was anticipated to comprise a thickness of Topsoil over silts, sands and clays of the London Clay Formation with sands of the Whitecliff Sand Member anticipated to be present in a limited portion across the centre of the site.

The ground conditions encountered within the exploratory holes undertaken were broadly consistent with those anticipated, i.e. a thickness of Topsoil overlying London Clay Formation, the Whitecliff Sand Member was not encountered within the exploratory hole positions undertaken, despite targeting of positions within the central portion of the site where this was anticipated to be present. A generalised summary of the encountered shallow ground conditions within investigation positions is presented in Table 5.1.

Top (m bgl)	Base (m bgl)	Geology	Positions
0.00	0.25 - 0.30	TOPSOIL: Grass over dark brown slightly sandy CLAY with frequent roots and rootlets.	All
0.25 - 0.30	5.00+	LONDON CLAY FORMATION: Soft to stiff orange and grey mottled CLAY with varying proportions of sand; Stiff to very stiff dark grey CLAY with varying proportions of sand; Soft to firm orange brown CLAY with varying proportions of sand and occasional rootlets; Orange and grey fine SAND with varying proportions of clay and silt.	All

Table 5.1 Summary of Ground Conditions

The exploratory hole logs are presented within Appendix B and the exploratory hole location plan is presented in Figure 2.

5.2 Groundwater

During the intrusive investigation works undertaken groundwater was encountered within a number of the investigation locations, details of which are provided in Table 5.2 below:

Location	Depth to water (m bgl)	Depth to water (m AOD)
WS01	Struck at 3.00m	44.23
WS02	Struck at 3.80m	46.56
WS03	Struck at 3.00m	51.80
WS08	Struck at 4.00m	50.77
WS11	Struck at 2.00m	Unable to obtain ground level

Table 5.2 Water strike during investigation works (December 2023)



Ground Investigation Report

Groundwater monitoring wells were installed within all locations, WS01-WS12 to a depth of between 3.00m and 5.00m bgl. Seven initial groundwater monitoring rounds were completed between December 2022 and April 2023, with further six monitoring rounds completed between June and August 2023 and the results of the groundwater monitoring are summarised in Tables 5.3 to 5.6 below.

Location	Groundwater depth (m bgl)									
	19/12/22*	09/01/23*	24/01/23*	08/02/23		21/02/23		06/03/23		11/04/23*
				Pre	Post	Pre	Post	Pre	Post	
WS01	0.50	0.45	0.58	0.73	0.83	0.95	1.07	1.03	-	0.89
WS02	0.62	0.36	0.14	0.14	0.39	0.40	0.65	0.49	0.80	0.72
WS03	0.60	0.18	0.36	0.82	0.89	1.23	-	1.55	-	0.48
WS04	0.60	0.30	0.27	1.00	-	0.68	2.51	1.48	-	0.73
WS05	0.13	0.16	0.38	0.58	1.87	1.20	-	0.70	3.91	0.24
WS06	0.14	0.14	0.10	0.85	2.68	0.70	1.29	1.46	-	0.28
WS07	0.22	0.18	0.35	0.62	0.68	0.36	1.01	0.77	2.66	0.25
WS08	0.14	0.14	At surface	0.00	0.53	1.01	-	0.80	1.66	0.66
WS09	0.66	0.25	0.24	0.61	2.71	0.67	3.09	0.64	4.15	0.40
WS10	0.21	At surface	At surface	0.01	0.15	0.02	0.05	0.06	0.48	0.42
WS11	0.46	0.41	0.39	0.42	2.54	0.76	3.68	0.76	4.12	0.79
WS12	0.05	0.28	0.34	0.46	2.02	0.53	3.02	0.44	3.63	0.28

*bailing of the monitoring wells was not undertaken on these visits

Table 5.3 Summary of initial groundwater depth monitoring results as m bgl (including pre- and post- bailing)

Location	Groundwater depth (m bgl)							
	16/06/23		23/06/23		10/07/23*	21/07/23*	04/08/23*	24/08/23*
	Pre	Post	Pre	Post				
WS01	1.31	-	1.45	-	1.84	1.92	2.08	2.14
WS02	1.03	-	1.01	-	1.18	1.14	1.14	1.05
WS03	1.95	-	2.13	-	2.41	2.42	2.59	2.59
WS04	2.04	-	1.13	-	1.53	2.30	2.32	2.32
WS05	1.13	-	1.21	-	1.45	1.57	1.64	1.75
WS06	1.71	-	1.83	-	2.10	2.14	1.98	1.86
WS07	1.04	-	1.11	-	1.32	1.42	1.56	1.46
WS08	1.28	-	1.36	-	1.57	1.67	1.32	1.04
WS09	1.36	-	1.46	-	1.81	1.87	1.94	2.10
WS10	0.51	0.87	0.71	0.88	1.04	1.06	0.63	0.54
WS11	0.84	3.96	0.92	4.01	1.10	1.07	0.98	0.90
WS12	0.97	3.86	1.07	-	1.24	1.32	1.36	1.37

*bailing of the monitoring wells was not undertaken on these visits

Table 5.4 Summary of further groundwater depth monitoring results as m bgl (including pre- and post- bailing)



Location	Groundwater depth (m AOD)									
	19/12/22*	09/01/23*	24/01/23*	08/02/23		21/02/23		06/03/23		11/04/23*
				Pre	Post	Pre	Post	Pre	Post	
WS01	46.73	46.78	46.65	46.50	46.40	46.28	46.16	46.20	-	46.34
WS02	49.74	50.00	50.22	50.22	49.97	49.96	49.71	49.87	49.56	49.64
WS03	54.20	54.62	54.44	53.98	53.91	53.57	-	53.25	-	54.32
WS04	42.24	42.54	42.57	41.84	-	42.16	40.33	41.36	-	42.11
WS05	Unable to obtain ground level with GPS									
WS06	44.91	44.91	44.95	44.20	42.37	44.35	43.76	43.59	-	44.77
WS07	49.69	49.73	49.56	49.29	49.23	49.55	48.90	49.14	47.25	49.66
WS08	54.63	54.63	54.77	54.77	54.24	53.76	-	53.97	53.11	54.11
WS09	56.03	56.44	56.45	56.08	53.98	56.02	53.60	56.05	52.54	56.29
WS10	57.87	58.08	58.08	58.07	57.93	58.06	58.03	58.02	57.60	57.66
WS11	Unable to obtain ground level with GPS									
WS12	59.49	59.26	59.20	59.08	57.52	59.01	56.52	59.10	55.91	59.26

*bailing of the monitoring wells was not undertaken on these visits

Table 5.5 Summary of initial groundwater depth monitoring results as m AOD (including pre- and post- bailing)

Location	Groundwater depth (m bgl)							
	16/06/23		23/06/23		10/07/23*	21/07/23*	04/08/23*	24/08/23*
	Pre	Post	Pre	Post				
WS01	45.924	-	45.784	-	45.394	45.314	45.154	45.094
WS02	49.339	-	49.359	-	49.189	49.229	49.229	49.319
WS03	52.856	-	52.676	-	52.396	52.389	52.216	52.216
WS04	40.805	-	41.715	-	41.315	40.545	40.525	40.525
WS05	Unable to obtain ground level with GPS							
WS06	43.348	-	43.228	-	42.958	42.918	43.078	43.198
WS07	48.874	-	48.804	-	48.594	48.494	48.354	48.454
WS08	53.491	-	53.411	-	53.201	53.101	53.451	53.731
WS09	55.339	-	55.239	-	54.889	54.829	54.759	54.599
WS10	57.576	57.216	57.376	57.206	57.046	57.026	57.456	57.546
WS11	Unable to obtain ground level with GPS							
WS12	58.573	55.683	58.473	-	58.303	58.223	58.183	58.173

*bailing of the monitoring wells was not undertaken on these visits

Table 5.6 Summary of further groundwater depth monitoring results as m AOD (including pre- and post- bailing)

It was not possible to obtain ground levels via GPS for WS05 and WS11 due to tree cover disrupting the GPS signal.

It is possible that groundwater could be present at differing depths over time, e.g. during or following prolonged wet periods, or as a results of seasonal variations. It must be noted that the presence of groundwater in excavations could influence stability and constructability of foundations, services and the like.

It should also be noted that changes in groundwater levels do occur for a number of reasons including seasonal effects and variations in drainage. Such fluctuations may only be recorded by the measurement of the groundwater level within a series of standpipes or piezometers installed within appropriate response zones.

5.3 Obstructions

Boreholes WS03, WS05, WS08 and WS10, experienced slumping within the encountered clays during construction which meant that the monitoring wells could not be installed to the full 5.00m depth proposed. As such monitoring well were installed to depths of between 3.00m and 5.00m bgl across the site.

Overhead electrical cables were located in the south-eastern portion of the site running in a northeast to southwest

direction. No boreholes were located under or within 15m of these cables.

No other obstructions man made or natural were encountered during the intrusive investigation works, although the presence of obstructions elsewhere on site cannot be completely ruled out.

5.4 Ground Gases and Vapours

Initial return 'spot' ground gas and groundwater monitoring has been undertaken on 7No. occasions, on 19th December 2022, 9th January, 24th January, 8th February, 21st February, 6th March 2023 and 11th March 2023 as part of the investigation, within wells installed within dynamic sampler boreholes WS01-WS12. Due to the depth of groundwater encountered during the initial gas monitoring visits and the need to bail the wells prior to gas monitoring, additional further ground gas and groundwater monitoring was undertaken during drier months. This further ground gas and groundwater monitoring was undertaken on 6No. occasions on 16th June, 23rd June, 10th July, 21st July, 4th August and 24th August 2023.

The spot monitoring undertaken, for both the initial and the further monitoring, has detected methane in the range of 0.0% to 5.4%, carbon dioxide detected in the range of 0.0% to 7.2% and oxygen in the range 2.1% to 22.3%. Positive borehole flow rates of between 0.0l/hr and 6.4l/hr were recorded during the monitoring, with positive borehole flows only recorded in a selection of wells over the monitoring period (WS01, WS02, WS04, WS05, WS07, WS08, WS10), and negative flow rates of -2.5l/hr, -0.4l/hr and -1.1l/hr were recorded within WS10 on 6th March, 16th June and 4th August 2023. VOCs were recorded up to 14.3ppm during the monitoring and atmospheric pressure was recorded in the range of 992mb to 1032mb, including periods of both falling and rising pressure, during the visits undertaken to date.

The implications of the gas monitoring data are considered in Section 6.0 of this report.

6.0 ENVIRONMENTAL CONSIDERATIONS

A Generic Quantitative Risk Assessment (GQRA) has been undertaken incorporating the results of the standalone desk study and Geo-Environmental ground investigation, the findings of which are presented in the following sections.

Site workers involved in the preparation and construction of the development have not been considered further in this assessment as the Principal Contractor is duty bound under the current CDM Regulations to undertake their own risk assessments with respect to their employees.

6.1 Outline Risk Assessment

Ground gas monitoring wells were installed across the site to target potential off-site sources and variations in anticipated site geology as well as to provide general site coverage to monitor the potential for any migrating ground gases onto the site from adjacent sources. Principal gases of concern are likely to include methane, carbon dioxide, oxygen and VOC together with parameters such as flow rate.

Soil samples were also collected from the site from the underlying natural soils and were submitted for analysis of Total Organic Carbon to aid with the ground gas risk assessment.

The intrusive investigation did not encounter conditions that required a revision of the preliminary risk assessment presented within the desk study for the site, although it should be noted that the Whitecliff Sand Member was not encountered as part of the investigation works undertaken to date.

6.2 Ground Gas/Vapour Monitoring

Twelve ground gas monitoring standpipes (WS01-WS12) were installed by Geo-Environmental on site to depths of up to 5.00m bgl. These locations were selected to provide general coverage of the site proposed for redevelopment, as well as to target the adjacent off-site landfill to the south of the site and the possible geological variation in the central western portion of the site.

Initial return 'spot' ground gas monitoring has been undertaken on 6No. occasions to date, on 19th December 2022, 9th January, 24th January, 8th February, 21st February, and 6th March 2023 as part of the investigation, within wells installed within dynamic sampler boreholes WS01-WS12. A seventh monitoring visit was undertaken following the 6No visits for ground gases, however the last visit on 11th April 2023 only monitored for groundwater levels so as to cover the winter monitoring period.

Due to the presence of shallow groundwater within a number of the installed monitoring wells further additional gas monitoring was undertaken during drier months. This further ground gas monitoring was undertaken on 6No. occasions on 16th June, 23rd June, 10th July, 21st July, 4th August and 24th August 2023.

The spot monitoring undertaken, for both the initial and the further monitoring, has detected methane in the range of 0.0% to 5.4%, carbon dioxide detected in the range of 0.0% to 7.2% and oxygen in the range 2.1% to 22.3%. Positive borehole flow rates of between 0.0l/hr and 6.4l/hr were recorded during the monitoring, with positive borehole flows only recorded in a selection of wells over the monitoring period (WS01, WS02, WS04, WS05, WS07, WS08, WS10), and negative flow rates of -2.5l/hr, -0.4l/hr and -1.1l/hr were recorded within WS10 on 6th March, 16th June and 4th August 2023. VOCs were recorded up to 14.3ppm during the monitoring and atmospheric pressure was recorded in the range of 992mb to 1032mb, including periods of both falling and rising pressure, during the visits undertaken to date.



6.3 Ground Gas Risk Assessment

A Tier 1 Ground Gas Risk Assessment (GGRA) incorporating the results of the desk study and ground investigation was undertaken, the findings of which are presented in the following sections.

Recommendations on acceptable gas concentrations recorded in the ground beneath or adjacent to buildings are given in a variety of publications. For the purpose of this assessment, the results have been evaluated in terms of British Standard BS8485, '*Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*' (2019); CIRIA C665, '*Assessing risks posed by hazardous ground gases to buildings*' (2007) and NHBC report 10627-R01(04) '*Guidance on evaluation of development proposals where methane and carbon dioxide are present*' (2007).

6.3.1 Ground Gas Sources

The desk study identified the potential for ground gases and vapours associated with four nearby former landfill sites to the south and west of the site. These landfill sites are considered to represent a potential source of ground gas due to the types of wastes that were permitted and deposited.

Fair Oak Landfill site does not lie immediately adjacent to the south of the subject site. An area of land comprising an open storage area in the west and woodland with a pond in the east, lies between the subject site and Fair Oak Landfill and is roughly 50m in width. In addition to this c.50m offset from Fair Oak Landfill a stream/ditch also runs along the southern boundary of the subject site.

The four nearby former landfill sites are assumed to be located within the Whitecliff Sand Formation. In addition, the Fair Oak Landfill study undertaken by Card on behalf of Eastleigh Borough Council in April 2012, identified a possible preferential pathway in Area G (adjacent to the southwest of the site) running south-north towards the subject site potentially influenced by the geological change from the Whitecliff Sand to the London Clay. However, during the intrusive investigation works undertaken on the subject site, no soils comprising the Whitecliff Sand were encountered. The soils underlying the site encountered to date comprised clays, sandy clays and clayey sands of the London Clay Formation.

There is active landfill gas collection and leachate management at Fair Oak Landfill site located to the south of the site. It is assumed that the gas engines would continue to operate whilst significant volumes of methane are generated within the relevant landfill cells. Under current conditions, it is assumed that the gas collection system within the landfill site boundary is working effectively, as indicated by the general absence of methane in the monitoring wells within the subject site.

It is possible that there could be a failure with the gas collector in the future or the gas collector system could be turned off as gas generated within the landfill reduces, and thus gas could migrate outside of the landfill site boundary associated with the this. However, this migration is unlikely to be uniform but subject to various additional factors, which would influence the likelihood of migration of gases onto the subject site. Lateral migration at shallow depth would have to travel across the site immediately adjacent to the landfill and would then be intercepted by the shallow stream/ditch running along the southern boundary of the site and thus ground gas could ventilate to atmosphere prior to reaching the subject site. The migration of gases is likely to occur through more permeable strata, to date only soils of the London Clay Formation have been identified on the subject site, therefore gases are more likely to migrate through permeable soils of the Whitecliff Sand Member, which present more preferential pathway. Soils of the Whitecliff Sand are known to present to the south and west of Fair Oak Landfill and groundwater flow is also understood to run in a southern westerly direction. Therefore, gas flow is likely to following these preferential pathways and be in a south westerly direction and so not anticipated to be towards the subject site.

It should also be noted that ground gas generation potential and migration of gas from landfills tends to reduce over time, i.e. as the degradable matter is depleted and initial anaerobic conditions give way to more aerobic conditions.



Therefore, whilst it is possible that the gas extractor system could be switched off in due course, the gas generation and migration potential from the off-site landfill would also likely be reduced at such time as this may occur.

In addition, it should be noted that the majority of the subject site where residential development is proposed is located at a higher elevation than the adjacent landfill site, which would also further serve to reduce the potential risk from any ground gas migration through the London Clay Formation.

6.3.2 Total Organic Carbon

An assessment of TOC was undertaken on the soils recovered from the exploratory hole positions undertaken on site in order to provide a further assessment of the background/baseline potential for ground gases to be present on the subject site associated with the underlying geology, prior to consideration of potential external sources which. It should be noted that this is a conservative approach as 'waste' material have never been recorded as being present on the subject site. In order for materials to be designated as inert for waste disposal purposes, the material must demonstrate a Total Organic Carbon (TOC) content of <3%. TOC gives a conservative estimate of the amount of biodegradable material in soils or waste. It includes both readily available carbon that degrades relatively quickly and non-readily available carbon that will breakdown and degrade very slowly.

A selection of soils samples collected from across the subject site were sent for geochemical laboratory analysis for %TOC. The results identified concentrations of TOC across the site between 0.12% and 1.9%, with an average of 0.38%.

CL:AIRE RB17 and BS8485:2015 use TOC results to classify a site in terms of anticipated gas risk. For recently placed material a TOC of <1% indicates a classification of Characteristic Situation 1, <1.5% indicates Characteristic Situation 2, and <4% indicates Characteristic Situation 3.

The average recorded concentration of TOC and all except 1No. TOC results (WS01 at 4.10m bgl) on this site is <1% therefore the overall results indicate that the site is Characteristic Situation 1 based solely on TOC on the subject site itself.

However, it should also be noted that the guidance relates to the placement of fresh waste. The materials encountered and tested on site comprised naturally occurring soils, as no Made Ground was found to be present during the investigation works undertaken. The natural soil on site is of a considerable age, and as such the residual total organic content will be comprised of complex non-readily available carbon and thus more representative of very low concentration generation potential and diffusive flow conditions. However, an assessment of the TOC serves to provide a background assessment for the site for the potential for presence of ground gases ahead of taking account of any potential migration from external sources identified.

6.3.3 Natural Soils

The encountered geology underlying the site was found to comprise clays and sandy clays of the London Clay Formation. Geological mapping shows an outcrop of Whitecliff Sand Formation running across the central western portion of the site, this outcrop of Whitecliff Sand Formation was not encountered during the intrusive investigation works undertaken. The underlying London Clay bedrock geology encountered is primarily formed of impermeable clay layers and as such is unlikely to represent a plausible migration pathway for ground gases.

Natural soils with a high carbonate content, such as Chalk, or sedimentary rocks with small volumes of organic material, can represent a low production source of carbon dioxide, which does not represent a risk to development. Soils such as the London Clay Formation are sedimentary strata which were laid down in a shallow sea environment. They can contain small volumes of non-labile organic carbon, shell fragments, calcareous nodules (claystone) and pyrites. Labile organic carbon is the portion of soil organic carbon that can be readily decomposed by soil organisms.

The breakdown of sedimentary rocks in this way is a very slow process typically with a turnover of many thousands



of years. Thus, surface emissions of methane and carbon dioxide from such sources are negligible. It can cause high gas concentrations in monitoring wells that are not representative of the risk to buildings, even those including basements. Such conditions are widespread throughout the UK with no known incidents of carbon dioxide emissions into buildings from this natural process.

When boreholes are drilled into the soils it allows oxygen to be introduced and various chemical and biological processes take place locally, immediately around the well that can result in the generation of higher concentrations of methane and/or carbon dioxide in the wells than within the wider soil mass. The rate of gas generation and the volume produced is extremely small and high concentrations in a monitoring well do not necessarily indicate a risk to buildings.

6.3.4 Assessment of Gas Monitoring Data

Initial Gas Monitoring

An assessment of the gas flow rates recorded within the initial return monitoring (first 6 visits) and the maximum concentrations of recorded hazardous gas concentrations recorded for the site has been undertaken.

Groundwater, considered likely to be perched water, was noted to be very shallow on a number of the initial gas monitoring visits undertaken. The response zone of several wells was noted to be fully submerged during a number of visits, such that it was necessary to bail/purge (i.e. remove water) the monitoring wells prior to gas monitoring. Following bailing/purging the wells were then allowed to recover for a period of time (c.1hr) prior to undertaking the gas monitoring. However, within several of the wells even bailing did not sufficiently remove water from the response zone, with the water noting to recharge to shallow levels within a reasonable short space of time. The response zones of all of the installed monitoring wells was from 1.00m bgl to between 3.20m and 5.00m bgl. Table 6.1 below shows the wells where the response zone was fully submerged during monitoring (in red text) and also presents the water depth following bailing and recovery of each well location. It should be noted that bailing was not undertaken on the first 3No. monitoring visits.

Location	Depth to water (m bgl)								
	19/12/22	09/01/23	24/01/23	08/02/23		21/02/23		06/03/23	
				Pre	Post	Pre	Post	Pre	Post
WS01	0.50	0.45	0.58	0.73	0.83	0.95	1.07	1.03	-
WS02	0.62	0.36	0.14	0.14	0.39	0.40	0.65	0.49	0.80
WS03	0.60	0.18	0.36	0.82	0.89	1.23	-	1.55	-
WS04	0.60	0.30	0.27	0.46	1.00	1.23	-	1.48	-
WS05	0.13	0.16	0.38	0.58	1.87	0.68	2.51	0.70	3.91
WS06	0.14	0.14	0.10	0.85	2.68	1.20	-	1.46	-
WS07	0.22	0.18	0.35	0.62	0.68	0.70	1.29	0.77	2.66
WS08	0.14	0.14	Surface	Surface	0.53	0.36	1.01	0.80	1.66
WS09	0.66	0.25	0.24	0.61	2.71	0.67	3.09	0.64	4.15
WS10	0.21	Surface	Surface	0.01	0.15	0.02	0.05	0.06	0.48
WS11	0.46	0.41	0.39	0.42	2.54	0.76	3.68	0.76	4.12
WS12	0.05	0.28	0.34	0.46	2.02	0.53	3.02	0.44	3.63

Table 6.1 Summary of encountered water levels during initial monitoring within monitoring wells including pre and post bailing levels with submerged response zone indicated in red text

It can be seen that during the first three monitoring rounds all of the response zones within all of the monitoring wells were fully submerged. In addition, the response zones of both WS02 and WS10 were fully submerged on all monitoring occasions even following the bailing/recovery of these wells.

As such, the gas monitoring data collected should be treated with caution, as due to response zones being fully submerged and the need to bail water out of the wells prior to monitoring and associated recharge, the monitoring



data collected may not be wholly representative of the sites gassing regime should a lower water level be present seasonally.

Gas flow rates have been recorded on a number of different occasions during the initial gas monitoring rounds within a number of different monitoring wells. However, on all of the occasions when flow rates were recorded the response zone of the well was either noted to be fully submerged and/or was recorded following the recharge of the well after bailing of the fully submerged well. A summary of the recorded borehole flow rates is presented in Table 6.2 below.

Location	Borehole Flow Rate (l/hr)								
	19/12/22	09/01/23	24/01/23	08/02/23		21/02/23		06/03/23	
				Pre	Post	Pre	Post	Pre	Post
WS01	0	0	0	0	0	0	0.3	0	-
WS02	0	0	0	0	0.2	0	4.2	0.2	5.7
WS04	0.10	6.4	0	0	0	0	-	0	-
WS05	0	0	0	0.2	0	0	0.5	0	0.5
WS07	0	0	0	0	0	0	0	0	4.0
WS08	0	0	0	0	4.0	0	0	0	3.0
WS10	0	0	0	0	0.3	0	0	-2.5	5.1

Table 6.2 Summary of recorded borehole flow rates with submerged response zone indicated in red text

The sole source of gas in the headspace of a standpipe within a fully submerged response zone is gases dissolved in groundwater. As the gas partitions out of the groundwater to within the confined headspace, the gas flow rate will initially increase within the confined headspace. This initial spike in gas flow rate occurs within the confined headspace (sealed monitoring well) only. Over time this will equalise through diffusive migration along concentration gradients within the groundwater. The groundwater contained within the standpipe above the response zone will remain immobile during this period, and as such the equalisation will take place over an extended period of time. Within the soils beneath the site any gases will partition in and out of groundwater within the open soil structure and will form a diffusive continuum between the surface of the groundwater and the ground surface meaning that gas flow rates are not present within the soils. As such, it is considered that the recorded borehole flow rates where a submerged response zone has been recorded are not representative of the actual flow rate of gases present within the soils beneath the site.

Methane was recorded on three separate occasions during the initial monitoring undertaken, as a peak, with the recorded methane volume returning back to zero for the following time period recording(s), within WS05 at 90 seconds on 9th January 2023 (1.0%), within WS07 at 20 seconds on 9th January 2023 (5.4%) and again within WS05 at 120 seconds on 8th February 2023 (0.3%). Methane was not recorded on any other occasions during the initial monitoring undertaken.

WS05 was located in the north-eastern portion of the site significantly topographically upgradient from the nearby landfills and WS07 was located within the central portion of the site also topographically upgradient from the landfill sites. Both monitoring wells were installed within natural soils of the London Clay Formation, and the presence of organic matter was not noted to be present within either well.

In all instances where methane was recorded the response zones of the wells during the initial monitoring rounds the wells were noted to be fully submerged. Therefore, the recorded peak methane volumes are not considered representative and based on the fact that methane has not been recorded during any other monitoring rounds, methane is not considered to be a risk to the proposed development of the site for a proposed residential land use.

It can be seen that marginal volumes of carbon dioxide were recorded in all standpipes located across the site, during the initial monitoring period, with monitoring location WS02 marginally exceeding the 5% limiting concentration for Characteristic Situation 1 on a total of 3No. separate occasions, 9th January, 21st February and 6th March 2023, and WS08 marginally exceeding the 5% limiting concentration on 1No. occasion on 21st February 2023.



As with methane, in all instances when carbon dioxide was recorded above the 5% limiting concentration threshold the monitoring wells were noted to be fully submerged.

WS02 was located in the northwest of the site and WS08 was located in the southwest of the site. Assessment of the construction of the wells and the underlying ground conditions has shown that the response zones of both WS02 and WS08 were installed within the natural London Clay Formation. The presence of organic matter was not noted to be present within either well.

Looking at atmospheric pressure conditions over the initial monitoring period, atmospheric pressure appears to have been both rising and falling preceding and during the monitoring rounds undertaken. There does not appear to be any correlation between the recorded carbon dioxide concentrations and atmospheric pressures. It is considered that atmospheric pressure has not impacted the recorded concentrations of carbon dioxide.

Further Gas Monitoring

An assessment of the gas flow rates recorded within the further return monitoring and the maximum concentrations of recorded hazardous gas concentrations recorded for the site has been undertaken.

The further gas monitoring was undertaken between June and August 2023 during the summer months, when the presence of shallow groundwater/perched water following rainfall events was considered less likely to impact on monitoring. The presence of perched/shallow groundwater within response zones was only noted within WS10, WS11 and WS12. The response zone of WS10 was noted to be fully submerged on 4No. occasions and WS11 on 1No. occasion. The response zones of all of the installed monitoring wells was from 1.00m bgl to between 3.20m and 5.00m bgl. Table 6.3 below shows the wells where the response zone was fully submerged during monitoring (in red text) and also presents the water depth following bailing and recovery of each well location. It should be noted that bailing was not undertaken on the last 4No. monitoring visits.

Location	Groundwater depth (m bgl)							
	16/06/23		23/06/23		10/07/23	21/07/23	04/08/23	24/08/23
	Pre	Post	Pre	Post				
WS01	1.31	-	1.45	-	1.84	1.92	2.08	2.14
WS02	1.03	-	1.01	-	1.18	1.14	1.14	1.05
WS03	1.95	-	2.13	-	2.41	2.42	2.59	2.59
WS04	2.04	-	1.13	-	1.53	2.30	2.32	2.32
WS05	1.13	-	1.21	-	1.45	1.57	1.64	1.75
WS06	1.71	-	1.83	-	2.10	2.14	1.98	1.86
WS07	1.04	-	1.11	-	1.32	1.42	1.56	1.46
WS08	1.28	-	1.36	-	1.57	1.67	1.32	1.04
WS09	1.36	-	1.46	-	1.81	1.87	1.94	2.10
WS10	0.51	0.87	0.71	0.88	1.04	1.06	0.63	0.54
WS11	0.84	3.96	0.92	4.01	1.10	1.07	0.98	0.90
WS12	0.97	3.86	1.07	-	1.24	1.32	1.36	1.37

Table 6.3 Summary of encountered water levels from additional monitoring within monitoring wells including pre and post bailing levels with submerged response zone indicated in red text

Gas flow rates have been recorded on four occasions during the further gas monitoring rounds within three different monitoring wells (WS05, WS07, WS10). However, on two of the occasions when flow rates were recorded the response zone of the well was noted to be fully submerged. The other two occasions when gas flow rates were recorded, the flow rate recorded was 0.1l/hr. A summary of the recorded borehole flow rates from the additional monitoring is presented in Table 6.4 below.



Location	Borehole Flow Rate (l/hr)						
	16/06/23		23/06/23		10/07/23	21/07/23	04/08/23
	Pre	Post	Pre	Post			
WS05	0	-	0.1	-	0	0	0
WS07	0	-	0.1	-	0	0	0
WS10	-0.4	-1.8	0	0	0	0	-1.1

Table 6.4 Summary of recorded borehole flow rates from additional monitoring with submerged response zone indicated in red text

It is considered that the recorded borehole flow rates where a submerged response zone has been recorded are not representative of the actual flow rate of gases present within the soils beneath the site. Therefore, the highest recorded gas flow rate is considered to be 0.1l/hr.

The presence of methane was not recorded within any of the monitoring wells during the further gas monitoring undertaken.

It can be seen that marginal volumes of carbon dioxide were recorded in all standpipes located across the site, during the further monitoring period, with monitoring location WS08 marginally exceeding the 5% limiting concentration for Characteristic Situation 1 on 1No. occasion on 16th June 2023.

WS08 was located in the southwest of the site adjacent to the residential development at Kingsmill Drive. Assessment of the construction of the well and the underlying ground conditions has shown that the response zones of WS08 were installed within the natural London Clay Formation. The presence of organic matter was not noted to be present within this well.

Looking at atmospheric pressure conditions over the further monitoring period, atmospheric pressure appears to have been both rising and falling preceding and during the monitoring rounds undertaken. There does not appear to be any correlation between the recorded carbon dioxide concentrations and atmospheric pressures. It is considered that atmospheric pressure has not impacted the recorded concentrations of carbon dioxide.

Summary of Gas Monitoring

Where the monitoring wells were fully submerged during the monitoring round, these monitoring results have not been considered as fully representative of the sites gassing regime, and therefore not relied upon within the gas risk assessment. A total of 12No. gas monitoring rounds were completed during both the initial and the further gas monitoring and it is considered that during both these phases of monitoring sufficient data was collected where monitoring wells were not fully submerged such to allow representative gas monitoring data to be collected and a sufficient gas risk assessment to be undertaken.

The majority of the marginal flow rates recorded within the boreholes were only recorded when the monitoring wells were either fully submerged or following the bailing of the monitoring well. As such, these recorded flow rates are considered to be caused by the piston effect of groundwater within the monitoring wells and draw of groundwater levels during bailing and recharge and are not considered representative of background conditions at the site. Therefore, where borehole flow rates have been recorded in fully submerged wells or recharging wells, these recorded flow rates have not been used to calculate gas screening values for the site, as they are considered as unrepresentative. This could lead to misrepresentative screening values and the site being incorrectly classified.

A borehole flow rate of 0.1l/hr was recorded within WS05 and WS07 on 23rd June 2023. Neither of these wells were submerged during this monitoring round and therefore this borehole flow rate is considered to be representative and therefore this value has been used to calculate gas screening values for the site.

During the initial gas monitoring undertaken between December 2022 and March 2023 the presence of methane was recorded only as a peak, with the recorded methane volume returning back to zero for the following time period



recording(s), on three separate occasions, all when the wells were full submerged. The presence of methane was not recorded on any other monitoring occasions. Therefore, a gas screening value has not be calculated for methane.

A gas screening value (GSV) has been calculated for carbon dioxide in accordance with the recommendations contained with C665. To calculate a GSV for the site, the worst case, i.e. the highest concentration value, of recorded carbon dioxide recorded when the monitoring well was not fully submerged, has been used. A value of 6.5% v/v has been used for carbon dioxide. The highest representative borehole flow rates recorded were 0.1l/hr within WS05 and WS07. CIRIA C665 recommends that when no gas flow rates have been recorded that the gas monitoring instruments limit of detection (0.1l/hr) is used to calculate the GSV so as to be representative of a worst-case scenario. In this case the highest recorded flow rate is the same value as the limit of detection of the instrument, 0.1l/hr.

Using these worst-case values, a GSV of 0.007l/hr has been calculated for carbon dioxide for the site. This would classify the site as representative of Characteristic Situation 1 (BS and CIRIA). However, the limiting threshold concentration for carbon dioxide for a Characteristic Situation 1 has been exceeded on several occasions. Therefore, consideration needs to be given to classification of the site as Characteristic Situation 2 gassing regime.

Monitoring wells WS10, WS11 and WS12 were located along the southern boundary of the site so as to target any potentially migrating gases from Fair Oak Landfill site c.50m to the south of the site. The presence of methane was not identified within any of these wells and carbon dioxide was identified at a maximum concentration of 2.6%. This coupled within the lack of identified representative significant flow rate and the cohesive predominantly impermeable underlying ground conditions across the site would suggest that gases are not migrating onto the site from the identified offsite former landfills.

Assessment of the construction of the wells and the underlying ground conditions has shown that all of the response zones of the installed wells were solely within the natural soils beneath the site. Description of these natural materials has not noted the presence of organic materials (with testing showing organic content of soils to be <3%) or other materials that may give rise to the generation of ground gas. Assessment of likely sources of ground gas has not identified any on-site sources for the significant generation of bulk gases.

As such, it is considered that the elevated concentrations of carbon dioxide recorded are being produced via biological respiration within the soils beneath the site and as such are from a low risk sources.

It is not mandatory to automatically increase the classification of a site based on elevated gas concentrations alone.

It is considered that carbon dioxide recorded is primarily trapped within the soil pore spaces beneath the site. The construction of the monitoring wells could have led to the creation of anaerobic conditions within the monitoring wells leading to an increase in carbon dioxide on a very small scale, within the monitoring well not the soil mass, producing the elevated concentrations recorded. The negligible flow rates suggest that any migration of gas beneath the site is via diffusive flow. However, the majority of identified gas is likely to remain trapped in the soil pores or sorbed to soil particles and is therefore considered a low risk to buildings or proposed buildings on the site. Therefore, it is not considered necessary to increase the classification of the site's gassing regime based on the single representative exceedance of the 5% threshold for carbon dioxide.

It is considered, based on the above assessment, that gases are not migrating from the nearby former landfill sites, that only diffusive flow conditions are present beneath the site, and that only low-risk sources of bulk gases are actually present on the subject site, due to the biological respiration within the underlying natural geology (London Clay Formation). In addition, it is also considered that should the active gas collector system present on Fair Oak Landfill site fail or be switched off, any gas would migrate via more preferential pathways based on underlying permeable soils, groundwater flow direction and topography in a south westerly direction away from the subject site.

6.4 Ground Gases vs. End Users

Based on the gas risk assessment undertaken by Geo-Environmental the site's gassing regime, based on both hazardous gas flow and limiting concentrations and the above risk assessment, is classified as Characteristic Situation 1 (CIRIA and BS) and Green (NHBC), for which gas protection measures would not be required.

6.5 Ground Gases vs. Soft Landscaping

Only low risk sources of bulk permanent gases have been identified on the site. Low concentrations of methane and carbon dioxide have been identified beneath the site. However, these gases are considered to be present and contained within soil pore spaces. It is considered that ground gas is migrating via diffusive flow only beneath the site. In addition, no visible evidence or harm to plants was observed during any of the site visits undertaken as part of the investigation on this site.

As such, it is considered that no specific action is warranted in respect of soft landscaping.

6.6 Ground Gases vs. Adjacent Land Users

No significant sources of ground gases or vapours have been identified on site therefore the potential for land gases off site is considered to be higher than those on the subject site. As such, it is considered that specific measures with respect to the adjacent land users would not be required as part of the proposed development on the subject site. However, in line with best practice, measures should be undertaken on site to ensure that the proposed development does not create potential migration pathways in relation to adjacent land users.

7.0 DISCOVERY STRATEGY

Whilst an intrusive investigation has been undertaken on the site, it remains possible that unexpected ground and/or groundwater conditions may be encountered during the process of construction.

Should previously undiscovered contamination or unforeseen ground conditions be encountered during construction by the ground workers, this must be reported to the Site Manager immediately in order that the Consultant is notified.

Where deemed necessary, the Consultant shall attend the site to inspect the discovery and provide recommendations on the further actions required, if any. Where necessary the regulatory authority shall be informed. Post any additional investigation or laboratory testing the results and any proposed remedial measures shall be reported to the regulatory authority or other appropriate organisation for consent, before proceeding or implementing the remedial measures.

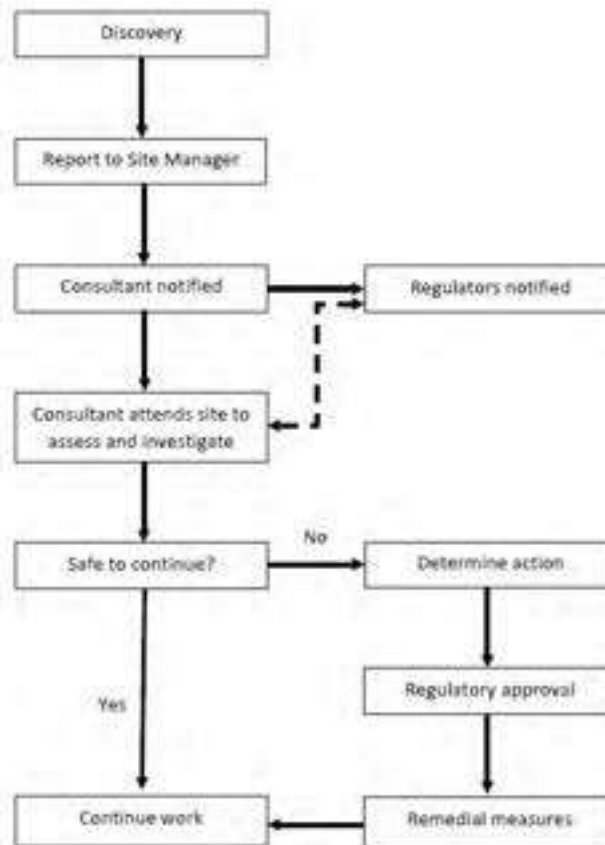
A copy of the discovery strategy must be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious, abnormal, unforeseen or contaminated ground and/or groundwater conditions they may encounter.

Depending on the type, nature and extent of any such 'discovery', it may be necessary to halt works in that location until such time as the assessment has been completed. This shall be reviewed on a 'discovery' specific basis and in conjunction with consultation with the client, other technical personnel and/or regulatory/approval organisations.

As a general guide, where such unexpected conditions are encountered the following approach is required as a minimum:

- All discoveries are to be reported to the Site Manager immediately and works at that location are to halt until further notice;
- The Site Manager is to report any such discoveries to the Client and the Consultant;
- Following notification from the Site Manager, the Consultant shall discuss the discovery with the Local Authority and/or other relevant parties and if considered necessary, arrange to meet on site to view the discovery;
- The Consultant shall attend the site to record the location, extent and nature of the discovery and implement an appropriate sampling and analysis regime, taking due account of the type and nature of the discovery, known and probable land uses in that area of the site;
- Where remedial action is required, regulatory consultation and approval will be sought;
- A record will be produced by the Consultant and held on site (with copies held by the Consultant, Client and Local Authority/other relevant organisation), detailing the discovery, assessment works undertaken, findings thereof, confirmation either of no action required or detailing the remedial action taken and validation thereof.

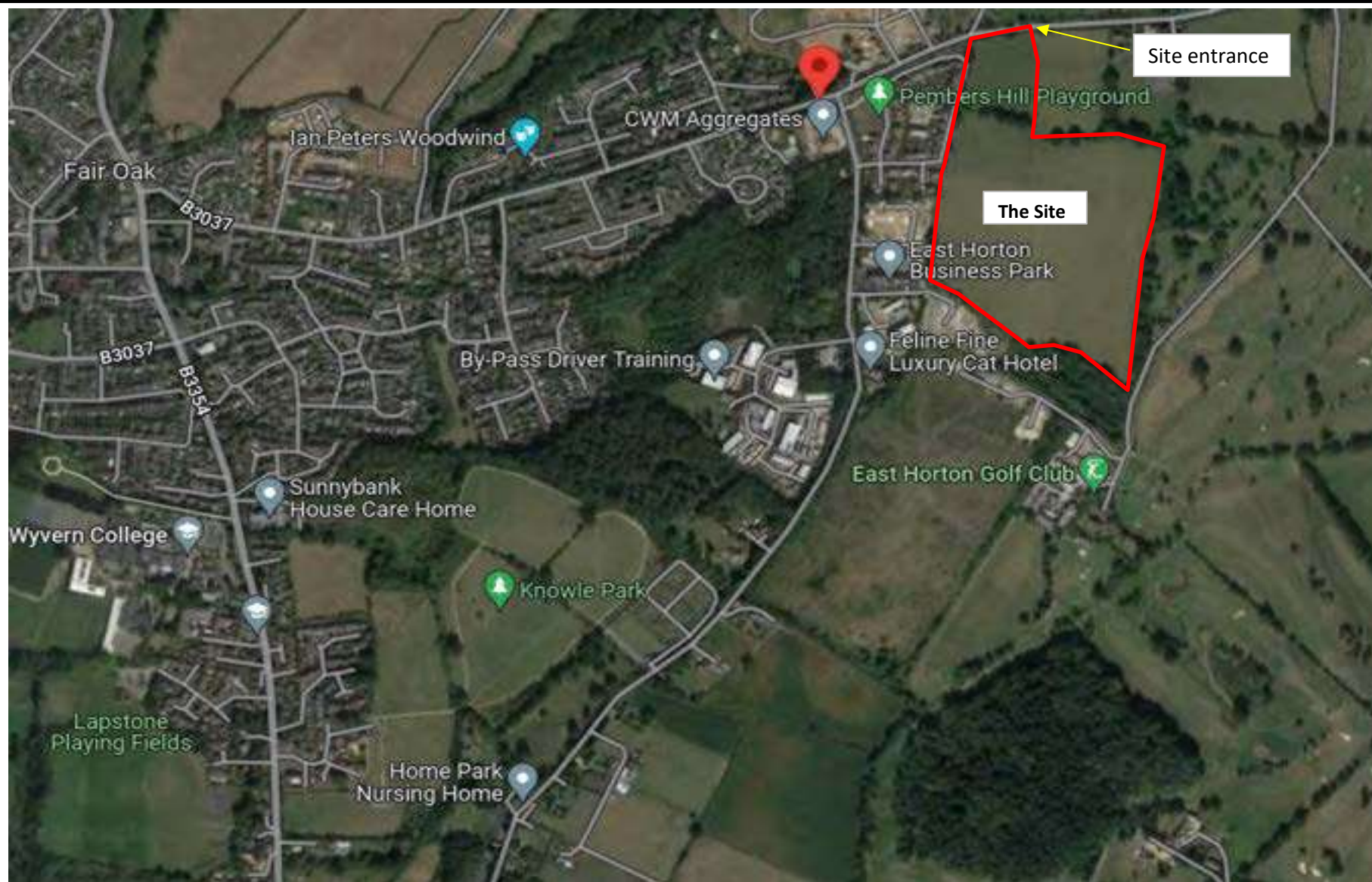
The process is summarised overleaf:



Discovery Strategy Process

FIGURES





Project:	Land South of Mortimers Lane, Fair Oak			Title	Site Location Plan	
Client:	Bloor Homes			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net  Geo-Environmental		
Ref No:	GE21215	Revision:	0			
Drawn:	FG	Date:	22/09/2022			
Figure:	1	Scale:	Not To Scale			



Project:	Land South of Mortimers Lane			Title	Investigation Locations (Ground Gas)		
Client:	Bloor Homes			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net  Geo-Environmental			
Ref No:	GE21215	Revision:	0				
Drawn:	FG	Date:	20/12/2022				
Figure:	2	Scale:	Not To Scale				

APPENDIX A

Site Photographs





Plate 1 View north from central portion of the site



Plate 2 View east across the site



Plate 3 View south west towards southern western corner of the site



Plate 4 View south with Fair Oak Landfill site beyond



Plate 5 View east across the site



Plate 6 View south east across the site



Plate 7 View south along western site boundary



Plate 8 View south east across southern field



Plate 9 View north along western site boundary



Plate 10 View south to south western corner



Plate 11 View south east of southern portion of the site



Plate 12 View east across the southern field



Plate 13 View north east across the southern field



Plate 14 View north across southern field



Plate 15 View east across southern field



Plate 16 View of Fair Oak Landfill site and gas extraction system



Plate 17 View of the offsite Fair Oak Landfill with gas extraction system



Plate 18 View west along the southern site boundary



Plate 19 View east along the southern site boundary



Plate 20 View south east towards south eastern corner



Plate 21 View east across the southern field



Plate 22 View north across the southern field



Plate 23 View west across the northern field



Plate 24 View south west from the access track



Plate 25 View south along the current farm/access track



Plate 26 View south west across the southern field



Plate 27 View wester across the southern field



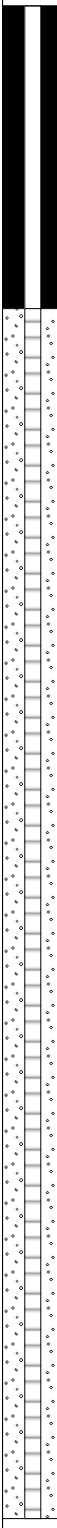
Plate 28 View east along the tree line located to the south of the northern field

APPENDIX B

Exploratory Hole Logs & In-situ Test Results



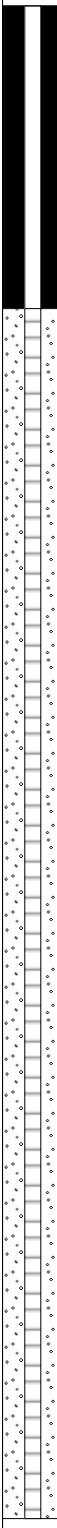
 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS01 Sheet 1 of 1	
Project Name: Land South of Mortimers Lane		Project No. GE21215		Co-ords: 450549E - 118583N		Hole Type WLS	
Location: Fair Oak				Level: 47.23		Scale 1:25	
Client: Bloor Homes Southern				Dates: 16/12/2022		Logged By FG	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.25			46.98		Grass over dark brown slightly sandy CLAY with frequent roots and rootlets TOPSOIL	1	
		0.80			46.43				Soft to firm orange and grey mottled sandy CLAY with frequent roots and rootlets LONDON CLAY
		1.00	PP	1.0kg/cm2	46.13			Firm orange and grey mottled sandy CLAY with frequent rootlets LONDON CLAY	2
		1.70			45.53			Soft to firm orange and grey mottled very sandy CLAY. Sand is fine LONDON CLAY	
		2.00	PP	2.1kg/cm2	45.13			Firm to stiff orange and grey mottled slightly sandy CLAY. Sand is fine LONDON CLAY	3
		2.50	PP	2.5kg/cm2				Stiff orange and grey mottled slightly sandy CLAY. Sand is fine LONDON CLAY	
		3.00	PP	2.0kg/cm2	44.13			Stiff dark grey slightly sandy CLAY. Sand is fine LONDON CLAY	4
		3.50	PP	2.5kg/cm2					
		4.00	PP	1.5kg/cm2					5
		4.10	ES						
4.50	PP	2.7kg/cm2							
5.00	PP	2.1kg/cm2	5.00		42.23	End of Borehole at 5.00m			

Dynamic Sampling Run Details			Water Strike Details (mbgl)		Remarks
Depth Top	Depth Base	Diameter	Depth Strike	Rose To	
			3.00	3.00	



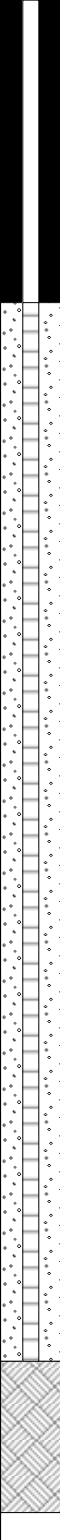
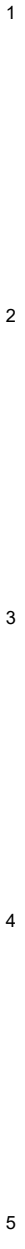
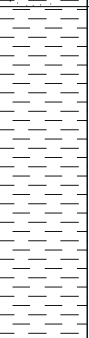
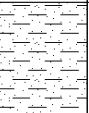
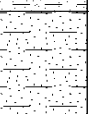
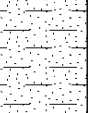
 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS02 Sheet 1 of 1	
Project Name: Land South of Mortimers Lane		Project No. GE21215		Co-ords: 450542E - 118633N		Hole Type WLS	
Location: Fair Oak				Level: 50.37		Scale 1:25	
Client: Bloor Homes Southern				Dates: 16/12/2022		Logged By FG	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.25	50.12		Grass over dark brown slightly sandy CLAY with frequent roots and rootlets TOPSOIL	1
		0.50	PP	1.3kg/cm2				Firm orange and grey mottled CLAY with frequent roots and rootlets LONDON CLAY	
		1.00	PP	1.0kg/cm2	0.80	49.57		Firm orange and grey mottled CLAY with occasional rootlets LONDON CLAY	
		1.50	PP	1.3kg/cm2	1.30	49.07		Firm orange and grey mottled CLAY with rare flint gravel LONDON CLAY	
		1.60	ES						
		2.00	PP	1.5kg/cm2					
		2.10			2.10	48.27		Stiff orange and grey mottled slightly sandy CLAY. Sand is fine LONDON CLAY	
		2.50	PP	2.5kg/cm2					
		3.00	PP	3.2kg/cm2					
		3.30			3.30	47.07		Dark grey slightly clayey silty fine SAND LONDON CLAY	
	3.90			3.90	46.47		Stiff dark grey slightly sandy CLAY. Sand is fine LONDON CLAY	4	
	4.50	PP	2.4kg/cm2						
	5.00	PP	2.5kg/cm2	5.00	45.37		End of Borehole at 5.00m	5	

Dynamic Sampling Run Details			Water Strike Details (mbgl)		Remarks
Depth Top	Depth Base	Diameter	Depth Strike	Rose To	
			3.80	3.80	



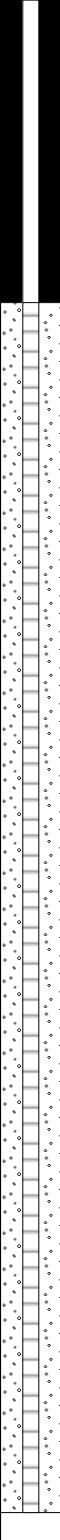
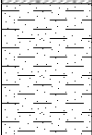
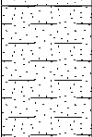
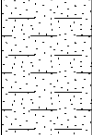
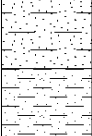
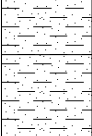
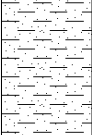
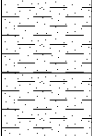
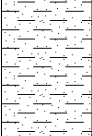
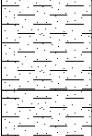
 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net				Borehole Log				Borehole No. WS03 Sheet 1 of 1	
Project Name: Land South of Mortimers Lane				Project No. GE21215		Co-ords: 450554E - 118711N		Hole Type WLS	
Location: Fair Oak				Level: 54.81		Scale 1:25			
Client: Bloor Homes Southern				Dates: 15/12/2022		Logged By FG			

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description						
		Depth (m)	Type	Results										
					0.20	54.61		Grass over dark brown slightly sandy CLAY with frequent roots and rootlets TOPSOIL						
		0.50	PP	1.4kg/cm2	0.60	54.21		Firm orange brown slightly sandy CLAY with occasional rootlets. Sand is fine LONDON CLAY						
		1.00	PP	2.5kg/cm2	1.70	53.11		Stiff becoming very stiff orange and grey mottled CLAY with occasional rootlets LONDON CLAY						
		1.40	ES	3.6kg/cm2										
		1.50	PP											
		2.00	PP	2.5kg/cm2	2.10	52.71		Stiff orange and grey mottled slightly sandy CLAY. Sand is fine LONDON CLAY						
										Orange and grey mottled slightly clayey silty fine SAND LONDON CLAY				
											3.30	51.51		Orange and grey mottled clayey silty fine SAND LONDON CLAY
		4.50	PP	1.2kg/cm2	5.00	49.81								
5.00	PP	1.4kg/cm2					End of Borehole at 5.00m							

Dynamic Sampling Run Details			Water Strike Details (mbgl)		Remarks
Depth Top	Depth Base	Diameter	Depth Strike	Rose To	
			3.00	3.00	



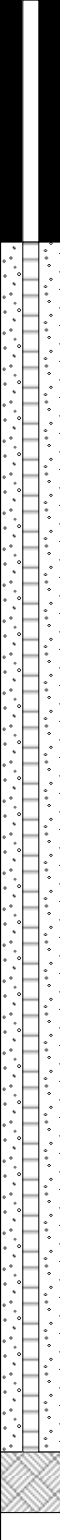
 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS04 Sheet 1 of 1	
Project Name: Land South of Mortimers Lane		Project No. GE21215		Co-ords: 450764E - 118486N		Hole Type WLS	
Location: Fair Oak				Level: 42.85		Scale 1:25	
Client: Bloor Homes Southern				Dates: 16/12/2022		Logged By FG	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.25	42.60		Grass over dark brown sandy CLAY with frequent roots and rootlets TOPSOIL	
					0.70	42.14		Firm orange brown very sandy CLAY with occasional roots and rootlets. Sand is fine LONDON CLAY	
					1.80	41.04		Orange brown clayey silty fine SAND with occasional bands of orange and grey mottled sandy CLAY LONDON CLAY	1
		2.00	PP	2.3kg/cm2	2.20	40.65		Stiff orange and grey mottled sandy CLAY. Sand is fine LONDON CLAY	2
		2.50	PP	2.0kg/cm2				Stiff orange and grey mottled slightly sandy CLAY. Sand is fine LONDON CLAY	
		2.60	ES						
		3.00	PP	2.1kg/cm2	3.15	39.70		Stiff dark grey slightly sandy CLAY. Sand is fine LONDON CLAY	3
		3.50	PP	2.9kg/cm2	4.10	38.74		Stiff dark grey sandy CLAY. Sand is fine LONDON CLAY	4
		4.00	PP	2.7kg/cm2					
		4.50	PP	1.8kg/cm2					
	5.00	PP	1.6kg/cm2	5.00	37.84		End of Borehole at 5.00m	5	

Dynamic Sampling Run Details			Water Strike Details (mbgl)		Remarks
Depth Top	Depth Base	Diameter	Depth Strike	Rose To	



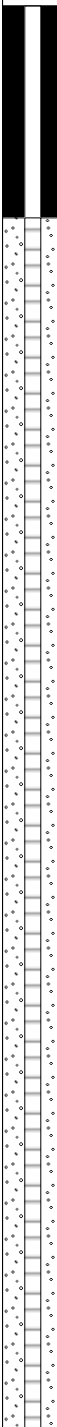
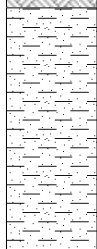
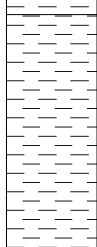
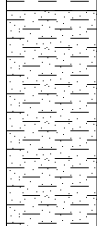
 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log			Borehole No. WS05 Sheet 1 of 1	
Project Name: Land South of Mortimers Lane		Project No. GE21215		Co-ords: 450841E - 118744N		Hole Type WLS
Location: Fair Oak				Level:		Scale 1:25
Client: Bloor Homes Southern				Dates: 16/12/2022		Logged By FG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.25		Grass over dark brown slightly sandy CLAY with frequent roots and rootlets TOPSOIL	1	
	0.50	PP	1.5kg/cm2		0.70		Firm orange brown slightly sandy CLAY with occasional roots and rootlets LONDON CLAY		
	1.00	PP	2.0kg/cm2		1.30		Stiff orange and grey mottled CLAY with rare rootlets LONDON CLAY	2	
	1.20	ES							
	1.50	PP	1.5kg/cm2		1.90		Firm to stiff orange and grey mottled CLAY LONDON CLAY		
	2.00	PP	1.4kg/cm2		3.10		Stiff brownish grey slightly sandy CLAY. Sand is fine LONDON CLAY	3	
	2.50	PP	1.7kg/cm2						
	3.00	PP	2.5kg/cm2						
	3.50	PP	2.8kg/cm2				Stiff becoming very stiff dark grey slightly sandy CLAY. Sand is fine LONDON CLAY	4	
4.00	PP	3.1kg/cm2							
4.50	PP	2.6kg/cm2							
					5.00		End of Borehole at 5.00m	5	

Dynamic Sampling Run Details			Water Strike Details (mbgl)		Remarks
Depth Top	Depth Base	Diameter	Depth Strike	Rose To	



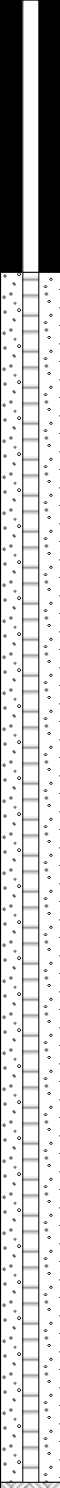
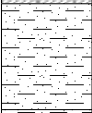
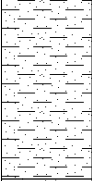
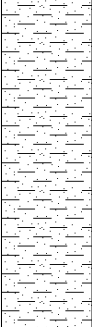
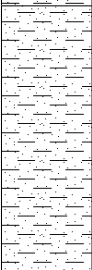
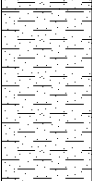
 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS06 Sheet 1 of 1	
Project Name: Land South of Mortimers Lane		Project No. GE21215		Co-ords: 450809E - 118551N		Hole Type WLS	
Location: Fair Oak				Level: 45.06		Scale 1:25	
Client: Bloor Homes Southern				Dates: 15/12/2022		Logged By FG	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					0.30	44.76		Grass over dark brown slightly sandy CLAY with frequent roots and rootlets TOPSOIL	1	
		0.50	PP	0.4kg/cm2				Soft to firm orange brown sandy wet CLAY with occasional roots and rootlets. Sand is fine LONDON CLAY		
		1.00	PP	0.5kg/cm2	1.10	43.96		Firm to stiff orange brown CLAY with occasional rootlets LONDON CLAY		
			1.50	PP	2.1kg/cm2	1.40	43.66		Firm to stiff orange brown CLAY LONDON CLAY	2
		2.00	PP	1.7kg/cm2						
		2.20	ES		2.20	42.86		Firm to stiff orange and grey mottled slightly sandy CLAY LONDON CLAY		
			2.50	PP	1.4kg/cm2					3
		3.00	PP	1.7kg/cm2						
		3.50	PP	1.5kg/cm2						
			4.00	PP	1.2kg/cm2					4
		4.50	PP	2.5kg/cm2	4.40	40.66		Stiff dark grey and slightly orange slightly sandy CLAY. Sand is fine LONDON CLAY		
		5.00	PP	2.0kg/cm2	5.00	40.06		End of Borehole at 5.00m	5	

Dynamic Sampling Run Details			Water Strike Details (mbgl)		Remarks
Depth Top	Depth Base	Diameter	Depth Strike	Rose To	



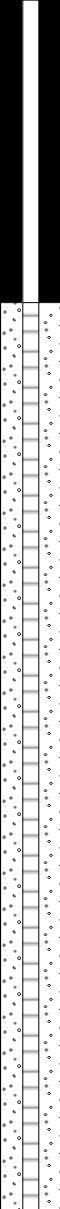
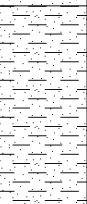
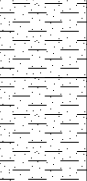
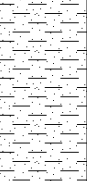
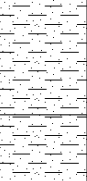
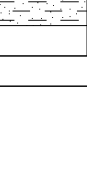
 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS07 Sheet 1 of 1	
Project Name: Land South of Mortimers Lane		Project No. GE21215		Co-ords: 450737E - 118632N		Hole Type WLS	
Location: Fair Oak				Level: 49.91		Scale 1:25	
Client: Bloor Homes Southern				Dates: 16/12/2022		Logged By FG	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.25	49.66		Grass over dark brown slightly sandy CLAY with frequent roots and rootlets TOPSOIL	1
		0.50	PP	1.1kg/cm2	0.60	49.31		Firm orange brown slightly sandy CLAY with occasional roots and rootlets LONDON CLAY	
		1.00	PP	1.1kg/cm2	1.20	48.71		Firm orange brown slightly sandy CLAY with rare rootlets. Sand is fine LONDON CLAY	2
		1.50	PP	0.8kg/cm2	2.00	47.61		Firm orange and grey mottled sandy CLAY. Sand is fine LONDON CLAY	
		2.00	PP	0.9kg/cm2	2.30	47.61		Stiff orange and grey mottled slightly sandy CLAY with rare ferrous inclusions. Sand is fine LONDON CLAY	3
		2.50	PP	2.1kg/cm2	3.00	46.71		Very stiff brownish grey slightly sandy CLAY. Sand is fine LONDON CLAY	
		3.00	PP	2.2kg/cm2	3.20	46.71		Very stiff dark grey slightly sandy CLAY. Sand is fine LONDON CLAY	4
		3.50	PP	3.9kg/cm2	3.70	46.11		Very stiff dark grey slightly sandy CLAY. Sand is fine LONDON CLAY	
		3.70	ES		4.00				5
		4.00	PP	3.0kg/cm2	4.50				
		5.00	PP	3.6kg/cm2	5.00	44.91		End of Borehole at 5.00m	

Dynamic Sampling Run Details			Water Strike Details (mbgl)		Remarks
Depth Top	Depth Base	Diameter	Depth Strike	Rose To	

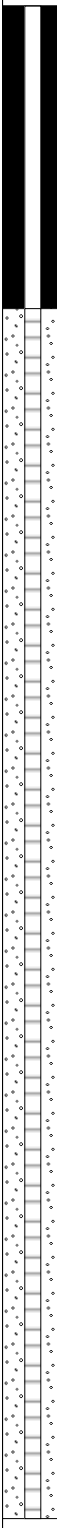
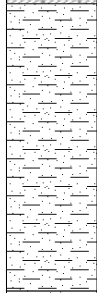


 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net				Borehole Log				Borehole No. WS08 Sheet 1 of 1	
Project Name: Land South of Mortimers Lane				Project No. GE21215		Co-ords: 450723E - 118756N		Hole Type WLS	
Location: Fair Oak				Level: 54.77		Scale 1:25			
Client: Bloor Homes Southern				Dates: 15/12/2022		Logged By FG			

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					0.25	54.52		Grass over dark brown sandy CLAY with frequent roots and rootlets TOPSOIL	1	
										Soft to firm orange brown sandy CLAY with frequent roots and rootlets. Sand is fine LONDON CLAY
					0.70	54.07				Firm orange brown slightly sandy CLAY with occasional roots and rootlets LONDON CLAY
		1.00	PP	1.5kg/cm2					Firm orange and grey mottled slightly sandy CLAY. Sand is fine LONDON CLAY	2
		1.20	ES						Soft to firm orange and grey mottled sandy sticky CLAY. Sand is fine LONDON CLAY	
		1.50	PP	1.4kg/cm2	1.40	53.37			Soft to firm orange brown very sandy sticky CLAY. Sand is fine LONDON CLAY	
		2.00	PP	1.0kg/cm2	2.20	52.57			Firm dark grey sandy CLAY. Sand is fine LONDON CLAY	3
										
					2.90	51.87				
							4.70	50.07		Firm dark grey sandy CLAY. Sand is fine LONDON CLAY
										
		5.00	PP	0.9kg/cm2	5.00	49.77		End of Borehole at 5.00m	5	

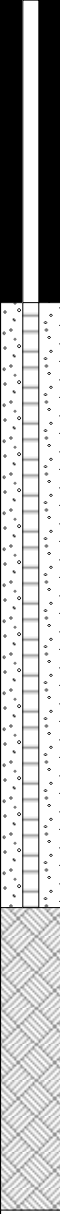
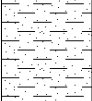
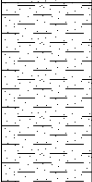
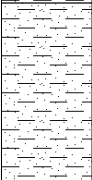
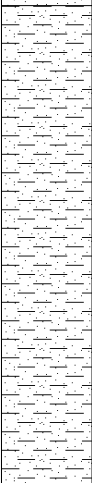
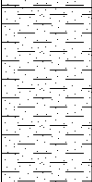
Dynamic Sampling Run Details			Water Strike Details (mbgl)		Remarks
Depth Top	Depth Base	Diameter	Depth Strike	Rose To	
			4.00	4.00	
					
Borehole slumping due to wet clays					

 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS09 Sheet 1 of 1	
Project Name: Land South of Mortimers Lane		Project No. GE21215		Co-ords: 450625E - 118749N		Hole Type WLS	
Location: Fair Oak				Level: 56.70		Scale 1:25	
Client: Bloor Homes Southern				Dates: 16/12/2022		Logged By FG	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.25	56.45		Grass over dark brown slightly sandy CLAY with frequent roots and rootlets TOPSOIL	1
		0.50	PP	1.4kg/cm2				Firm orange brown slightly sandy CLAY with occasional roots and rootlets LONDON CLAY	
		1.00	ES						
		1.00	PP	1.1kg/cm2	1.20	55.50			
		1.50	PP	1.5kg/cm2					2
		2.00	PP	2.0kg/cm2					
		2.50	PP	1.0kg/cm2	2.50	54.20		Firm to stiff orange and grey mottled slightly sandy CLAY. Sand is fine LONDON CLAY	
		3.00	PP	2.5kg/cm2					3
		3.20							
		3.50	PP	2.1kg/cm2				Firm to stiff brownish grey slightly sandy CLAY. Sand is fine LONDON CLAY	
	4.00	PP	2.4kg/cm2					4	
	4.50	PP	3.0kg/cm2						
	5.00	PP	3.5kg/cm2	5.00	51.70		Stiff becoming very stiff dark grey slightly sandy CLAY. Sand is fine LONDON CLAY		
							End of Borehole at 5.00m		5

Dynamic Sampling Run Details			Water Strike Details (mbgl)		Remarks
Depth Top	Depth Base	Diameter	Depth Strike	Rose To	



 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net				Borehole Log				Borehole No. WS10 Sheet 1 of 1	
Project Name: Land South of Mortimers Lane				Project No. GE21215		Co-ords: 450591E - 118850N		Hole Type WLS	
Location: Fair Oak				Level: 58.09		Scale 1:25			
Client: Bloor Homes Southern				Dates: 15/12/2022		Logged By FG			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.25	57.84		Grass over dark brown slightly sandy CLAY with frequent roots and rootlets TOPSOIL	1
		0.50	PP	1.5kg/cm2	0.60	57.49		Firm orange and grey mottled slightly sandy CLAY with occasional roots and rootlets LONDON CLAY	
		1.00	PP	2.0kg/cm2	1.20	56.89		Firm to stiff orange and grey mottled slightly sandy CLAY with rare rootlets. Sand is fine LONDON CLAY	2
		1.50	PP	1.2kg/cm2	1.80	56.29		Firm orange and grey mottled sandy CLAY. Sand is fine LONDON CLAY	
		2.00	PP	0.5kg/cm2				Soft orange and grey mottled sandy sticky CLAY. Sand is fine LONDON CLAY	3
		3.50	PP	0.9kg/cm2	3.40	54.69		Firm brownish grey slightly sandy CLAY. Sand is fine LONDON CLAY	
		4.00	PP	1.5kg/cm2	4.00	54.09		End of Borehole at 4.00m	
									5
Dynamic Sampling Run Details		Water Strike Details (mbgl)		Remarks					
Depth Top	Depth Base	Diameter	Depth Strike	Rose To	Sides unstable due to wet clays slumping in borehole				

