



**Geo-Environmental**

**GROUND INVESTIGATION REPORT**

**for the site at**

**NORTH HORSHAM PHASE II,**

**OFF RUSPER ROAD, HORSHAM,**

**WEST SUSSEX, RH12 4QR.**

**on behalf of**

**LEGAL & GENERAL STRATEGIC LAND NORTH HORSHAM LTD**



|                                                                                                                                                                                                       |                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Report:                                                                                                                                                                                               | GROUND INVESTIGATION REPORT                                                    |
| Site:                                                                                                                                                                                                 | NORTH HORSHAM PHASE II, OFF RUSPER ROAD, HORSHAM, WEST SUSSEX, RH12 4QR        |
| Client:                                                                                                                                                                                               | LEGAL AND GENERAL STRATEGIC LAND NORTH HORSHAM LIMITED                         |
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| EXECUTIVE SUMMARY           |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | Site Address        | North Horsham Phase II, Off Rusper Road, Horsham, West Sussex, RH12 4QR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                             | Form of Development | Construction of residential properties with gardens, commercial properties, sports pitches, car parking, access roads and associated infrastructure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Encountered Conditions      | Scope of works      | An intrusive investigation to confirm the ground and groundwater conditions and support the development of geotechnical and geo-environmental assessments of the site in relation to the proposed development.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                             | Ground Conditions   | The ground conditions generally comprised a limited thickness of Topsoil overlying the Tunbridge Wells Sand Formation and the Weald Clay Formation. A few holes recorded a thin mantle of Made Ground overlying the solid geology, but these holes were mostly around the margins of fields or within field entrances.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                             | Groundwater         | <p>During the investigation groundwater was encountered at depths of between 0.87m and 12.50m bgl. After twenty minutes, standing water depths were recorded between 2.20m bgl to 2.90m bgl within the trial holes. Artesian water strikes were encountered within BH101 and BH104 at depths of 12.50m bgl and 8.50m respectively. The water was observed to rise to between 0.80m and 2.20m above ground level within the borehole casing. The artesian strikes were sealed out using a bentonite plug.</p> <p>Six monitoring visits have been undertaken. During the visits, water levels were recorded at depths of between 0.90m and 2.90m bgl.</p> <p>It is recommended that a pilot hole is drilled using rotary techniques immediately adjacent to any deep excavations prior to construction, to investigate the potential for artesian groundwater within the depth of the proposed excavation.</p>                                                                  |
| Geotechnical Considerations | Foundations         | <p>Based on the ground and groundwater conditions encountered in the boreholes conventional foundations are considered suitable for the proposed development remote from trees.</p> <p>It is recommended that in lieu of any further investigation to delineate areas of potential low volume change soils, the Weald Clay and Upper Tunbridge Well Sand Formations be classified <i>en masse</i> as Medium Volume Change Potential in accordance with the NHBC Standards, Chapter 4.2. A minimum founding depth within the Weald Clay and Upper Tunbridge Wells Sand Formations of 0.90m is therefore applicable remote from trees. Foundations should not be less than 450mm in width.</p> <p>Based on the results of in-situ tests and typical settlement parameters for the types of soil encountered, a maximum allowable bearing capacity of 150kPa is applicable for trench, strip or isolated pad foundations up to 1.50m in width taken through any Made Ground,</p> |



|  |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |                 | soft or loose zones, desiccated or disturbed soils and placed wholly into or onto the stiff silty clays of the Weald Clay or Upper Tunbridge Wells Sand Formations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|  | Floor Slabs     | Based on the presence of trees and shrinkable soils, suspended ground floor slabs should be utilised.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|  | Excavations     | <p>Shallow excavations within the Weald Clay Formation and Tunbridge Wells Sand Formation across the site are likely to remain relatively stable in the short term. However, longer deeper excavations and granular horizons within the Weald Clay Formation may be prone to instability and some form of temporary support or battering back to a safe angle may be required. Where excavations intercept groundwater under artesian pressure significant construction difficulties will occur together with potential rapid surface flooding. This is not likely to impact residential parcels and would only be of concern for deep piles and deep drainage and locations of pumping stations. The groundworks contractor should be made aware of the potential to intercept artesian groundwater at depth and should provide a contingency to seal the flow of water and mitigate potential surface flooding if encountered.</p> <p>It is recommended that a pilot hole is drilled using rotary techniques immediately adjacent to any deep excavations prior to construction, to investigate the potential for artesian groundwater within the depth of the proposed excavation.</p> |
|  | Pavements       | Based on the laboratory results, in-situ testing and TRRL report LR1132, an equilibrium suction index CBR value of 4% is recommended.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|  | Drainage        | The results of indicative falling head tests indicate the Weald Clay and Upper Tunbridge Wells Sand to have negligible soakage potential. Conventional soakaways are therefore highly unlikely to function effectively, and an alternative form of stormwater drainage system should be used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|  | Buried Concrete | <p>Six pH and Sulphate tests were undertaken on the Tunbridge Wells Sand Formation. The results for the Tunbridge Wells Sand Formation corresponded to design class DS-1 as defined within the BRE Special Digest 1 (2005). The pH analyses indicate the ACEC class to be AC-1s. It is recommended that a design class of DS-1 and an ACEC class of AC-1s be applied to all sub-surface concrete within this stratum.</p> <p>Thirty-eight pH and Sulphate tests were undertaken on the Weald Clay Formation (static groundwater). The results for the Tunbridge Wells Sand Formation corresponded to design class DS-1 as defined within the BRE Special Digest 1 (2005). The pH analyses indicate the ACEC class to be between AC-1s. It is recommended that a design class of DS-1 and an ACEC class of AC-1s be applied to all sub-surface concrete within this stratum.</p>                                                                                                                                                                                                                                                                                                           |



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   | Fourteen pH and Sulphate tests were undertaken on the Weald Clay Formation (mobile groundwater). The results for the Weald Formation corresponded to design classes DS-1 to DS-2 as defined within the BRE Special Digest 1 (2005). The pH analyses indicate the ACEC class to be between AC-1s to AC-3.                                                                                                                                                                                                              |
| Considerations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Human Health      | <p>The results of the chemical testing on the Topsoil, Made Ground, natural soils (Tunbridge Wells Sand Formation &amp; Weald Clay Formation) have been compared directly with the generic assessment criteria for the proposed end use. All of the results were below the relevant thresholds indicating that the environmental quality of the natural soils had not been impacted.</p> <p>The laboratory testing of the samples did not identify any asbestos.</p>                                                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Ground gas        | Based on the monitoring results, ground gas protection measures are not required.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Built Environment | Pipes are to be designed to be wholly placed in natural soils of the Weald Clay Formation and Tunbridge Wells Sand Formation and therefore barrier pipe is not considered a requirement.                                                                                                                                                                                                                                                                                                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Waste Disposal    | <p>Initially, the results of the laboratory testing were submitted for HazWaste classification, the results confirmed that the near surface soils were non-hazardous for disposal. The summary of the results of the HazWaste classification are within Appendix E.</p> <p>Natural soils (Tunbridge Wells Sand Formation &amp; Weald Clay Formation) are likely be classified as Inert Waste (under the respective EWC codes for naturally occurring soils), suitable for disposal at an inert landfill facility.</p> |
| <p>Further Actions:</p> <p><b>Pre Construction</b></p> <ul style="list-style-type: none"> <li>The results of this investigation be presented to the water utility company as soon as reasonably practicable to confirm the appropriate water pipe material.</li> <li>Further investigation of the easternmost portion of the site, between crop cycles.</li> </ul> <p><b>During Construction</b></p> <ul style="list-style-type: none"> <li>A discovery strategy should be maintained during development such that any abnormal conditions (geotechnical or potential contamination) are identified and their potential impact on the proposed development assessed prior to determining any potential mitigation measures.</li> </ul> |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |



## 1.0 INTRODUCTION

Geo-Environmental Services Limited was instructed by Legal & General Strategic Land North Horsham Limited to undertake an investigation of the geotechnical and geo-environmental factors pertaining to North Horsham Phase II, Off Rusper Road, Horsham, West Sussex, RH12 4QR. The site's location is presented in Figure 1.

Geo-Environmental Services Limited had previously prepared a Desk Study Report (GE20724-DSR-MAY22) issued for the site on behalf of Legal & General Strategic Land North Horsham Limited, to which reference should be made.

### 1.1 Development Proposals

The south-western portion of the site is proposed to be developed with a recreation sports area including a pavilion, MUGAs and pitches. The southern area of the site is allocated as employment land, with the north, north-eastern and north-western portions being developed for residential use including houses and apartments with private and communal gardens, soft landscaping, public open space and associated infrastructure including pumping stations. A new access road is to be formed leading from the A264 along the southern boundary and looping around northwards within the development.

### 1.2 Site Description

The wider site comprised an irregular shaped plot of land (c.96Ha), located just north of Horsham town. The topography of site generally sloped gently, with the higher ground located in the north. The current site was predominately agricultural, but also included a few scattered residential and commercial properties. For the purposes of the site description, the site has been split into 14No. areas, with the section below providing a brief description for each. The areas described below are indicated on Figure 1a.

Area 1 was situated in the northwest of the wider site and was roughly square in shape. The field was being utilised to graze sheep and horses in several paddocks. A tree lined barbed wire fence ran the perimeter of the area. The area was grassed and sloped gently southwards. Immediately northwest of the plot several residential properties were present, including Hawkesbourne Park Farm which comprised multiple buildings and a riding school, to the east a large section of woodland and to the north and south further agricultural land.

Area 2 was situated in the northwest of the wider site and was irregular in shape. The field was generally flat and in use as arable farmland. The surface comprised the short stubble of a recently harvested crop. The field was tree lined to the north, west and south with a section of woodland present to the east. To the southwest of the area, Bohunt Horsham Secondary School was present.

Area 3 was situated in the west of the wider site, was roughly rectangular in shape and generally level. Within the eastern portion, a large pond was present. Surrounding the pond several large shrubs and semi mature trees were present. The remainder of the plot comprised a hummocky grassed field. A small orchard bordered the field to the east, a thin section of woodland and Channells Brook was present to the south, Bohunt Horsham Secondary School was located to the west and agricultural land to the north.

Area 4 was located in the southwest of the wider site and was irregular in shape. The plot had a gentle slope to the southwest. In the west of the area, the Topsoil had been stripped across the field, leaving the subsoil exposed which was heavily cracked. Several large stockpiles were present, which covered the majority of the land in the west. The stockpiles appeared to comprise natural Topsoil and subsoil. The field was bound by trees on all sides, Channells Brook was located to the north and west of the field, the A264 was present to the south.

A Heras fence had been erected running from north to south separating the eastern section of the area which was grassed.

Area 5 was located in the west of the wider site and comprised a roughly triangular, level plot of land. A mature orchard was present in the north with a allotment. The area was fenced therefore, internal inspection was not possible. To the south, a mature woodland was present with Channells Brook running through the southern section.

Area 6 was located in the southwest of the site and comprised a roughly triangular, level plot of land. The field was grassed with a footpath running around the perimeter which was in use by dog walkers. The southern boundary of the field comprised a mature hedge, the northern and western boundaries comprised wooded areas with a footpath to the east.

Area 7 was located in the southwest of the wider site and was irregular in shape. The plot was generally level and comprised hummocky grass. As with Area 6 a footpath ran around the perimeter of the field and was in use by dog walkers. The plot was bound on all sides by trees, the A264 was present to the south.

Area 8 was located in the central section of the wider site and was roughly rectangular in shape. The area comprised a cropped field. The field was generally level with a hedge and several trees running the length of the fields southern boundary. A footpath was present to the west. A small section of woodland was located to the east. Channells Brook ran to the north.

Area 9 was the largest area present and was located in the south of the wider site. The area was generally level and rectangular in shape. The field was cropped with a narrow footpath running around the perimeter of the plot in use by several dog walkers. Two railways lines running on an embankment tracked the southern boundary of the field. A mature hedge and trees lined the northern perimeter, a single vehicular access track was present to the east and a footpath was present to the west. Overhead services were present in the east running from south to north.

Area 10, the smallest area, was located in the south of the wider site. the area was roughly rectangular in shape with the majority of the plot overgrown with brambles and was generally level, however, the access point leading to Crawley Road, dropped down into site c.2m. A small derelict wooden building with metal clad roof was present within the southeast portion. A small stockpile of soil had been placed by the access gate to prevent illegal access. The area was bound on all four sides by trees. The railway lines ran to the north of the plot, the A264 ran to the south and west, arable land was present to the east.

Area 11 was located in the southeast of the wider site and was roughly rectangular in shape. The field was generally level and ad recently been ploughed/drilled. Trees were present along the eastern, southern and western perimeters. The area was bound to the north by the railway, to the south the A264, to the east Wimland Road. General litter and household waste was present on the bank adjacent to Wimland Road.

Area 12 was located in the east of the wider site and was irregular in shape. The central and southern sections of the field were cropped. The concrete structure of a derelict agricultural barn was present in the east of the area. Several suspected cement bound asbestos corrugated roof sheets remained on the structure. The land surrounding the delict barn were largely overgrown by brambles. In the northeast, semi-detached houses were present with access onto Wimland Road. To the rear of the houses a double story metal clad building was present, in use by Mickel Motor Sport. The area immediately surrounding the building was used for storing vehicles and towable signs. Several drums of 'Hyper Flow Plus' were observed alongside general waste outside of the Mickel Motorsport Unit. No evidence of surface staining was noted on-site. A small bonfire area was

present to the rear of the building. A grassed paddock was present in the north. The majority of the area was bound by mature hedges with stands of woodlands to the north and south. A small brook was present to the north and Channells Brook was present to the south. Overhead services were present in the south, running from west to east and tracking the south eastern boundary running north to south.

Area 13 was located in the north east of the wider site. the area comprised a grassed field. The field was irregular in shape and sloped gently to the south. Trees lined the north, south and western perimeter. Further grassed paddocks bordered the east.

Area 14 was located in the north east of the wider site and was roughly rectangular in shape. The area sloped gently to the south. A small stockpile of demolition waste was present in the east comprising brick and concrete within soil. The field was grassed, with trees lining the perimeter on all sides with areas of woodland beyond. The south eastern section was bounded by a thin section of trees.

### **1.3 Previous Reports**

Geo-Environmental Services Limited has previously undertaken work at the site on behalf of Legal & General Strategic Land North Horsham Limited. The works comprised a Desk Study Report (GE20724-DSR-MAY22) issued on 22<sup>nd</sup> June 2022 (second issue), to which reference should be made.

A summary of relevant sections relating to the Preliminary Risk Assessment are presented in the following section.

Information provided by the client as part of the quotation information included four reports for investigations undertaken on the phase I area, west of the site. The reports provided were as follows:

- Hydrock – Ground Investigation Report (ref: C-11746-C-HYD-xx-xx-RP-GE-1000) dated 21/08/2019.
- Endeavour Drilling – Ground Investigation Report (Factual) (ref: END20-007) dated March 2020
- Hydrock – Ground Gas Monitoring Assessment (ref: 11746-HYD-xx-xx-RP-G-1001) dated 23<sup>rd</sup> July 2021.
- Stantec – Ground Investigation Report (ref: 25216/3503/R003/Rev1) dated October 2021.

For further details, please refer to the report referenced.

### **1.4 Standards**

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

- British Standards Institute - Code of Practice for Earth Retaining Structures (BS8002:2015).
- British Standards Institute - Code of Practice for Site Investigations (BS5930:2015+A1:2020).
- British Standards Institute - Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings (BS8485:2015+A1:2019).
- British Standards Institute - Eurocode 7 - Geotechnical Design - Parts 1 & 2 (BS EN1997-1:2004 & BS EN1997-2:2007).
- British Standards Institute - Guidance on investigations for ground gas. Permanent gases and Volatile Organic Compounds (VOCs) (BS8576:2013).
- British Standards Institute - Investigation of Potentially Contaminated Sites - Code of Practice (BS10175:2011+A2:2017).



- British Standards Institute - Soils for Civil Engineering Purposes (BS1377:1990).
- British Standards Institute - Specification for Topsoil and Requirements for Use (BS3882:2015).
- Building Research Establishment - Soakaway Design - DG 365 (2016).
- Building Research Establishment - The Performance of Building Materials in Contaminated Land (BRE255) (1994).
- Construction Industry Research and Information Association - Assessing risks posed by hazardous ground gases to buildings (C665) (2007).
- Department for Environment Food and Rural Affairs and CL:AIRE - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination (SP1010) (2014).
- Department of Environment - Industry Profiles (1995 - 1996).
- Environment Agency - Guidance for waste destined for disposal in landfills (2006).
- Environment Agency - Guidance on Requirements for Land Contamination Reports (2005).
- Environment Agency - Land Contamination: Risk Management (LCRM) (2020).
- Ministry of Housing, Communities and Local Government - National Planning Policy Framework (2019).
- National House Building Council, Environment Agency & Chartered Institute of Environmental Health - Guidance for the Safe Development of Housing on Land Affected by Contamination (R&D Publication 66) (2008).
- National House Building Council - Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present (10627-R01[04]) (2007).
- National House Building Council - Standards, Chapter 4.1 Land Quality - Managing Ground Conditions (2020).
- West Sussex County Council – Guidance for the Design of Road Pavement Foundations – Standard Detail S278/38/21 (2021).

## 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 the geotechnical assessment may not be fully compliant with that design code, due to the access restrictions at the time of the fieldworks and methods of investigation adopted. 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 data collected from the investigations have been used to provide an interpretation of the 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 occurs between or under points of physical investigation. Whilst every effort has been made to interpret the conditions, such information is only indicative and liability cannot be accepted for its accuracy.

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. 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 any third parties against any dispute or claim arising from any finding or other result of this investigation report or any consequential losses, without the third party first entering into a reliance agreement with Geo-Environmental, this agreement also being approved by the Client or current Beneficiary.

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, and exposure to contaminants and levels of adverse effects may therefore vary. Whilst every 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.



## 2.0 SUMMARY OF PREVIOUS REPORT

### 2.1 Desk Study Summary

The following sections provide a summary of the key findings of the desk study.

#### 2.1.1 Geotechnical Risk Assessment

The following factors that might impact the geotechnical condition of the site were identified as part of the desk study:

| Geotechnical Hazard                               | Probability         | Engineering Implications                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lateral changes in ground conditions              | Likely              | Variable ground conditions posed by the differing bedrock and superficial geologies across the site may affect foundation design, construction and zoning.                                                                                                                                                                  |
| Shrinkable soils                                  | Negligible - medium | The Upper Tunbridge Wells Sand Formation is predominantly non-plastic. The Weald Clay Formation has predominately medium plasticity.                                                                                                                                                                                        |
| Significant depths of Made Ground                 | Unlikely            | The site has remained largely undeveloped, therefore significant depths of Made Ground is not anticipated. However, sections of the site have been historically developed, localised areas of deeper Made Ground are possible.                                                                                              |
| Aggressive chemical ground conditions (sulphates) | Likely              | The possible presence of pyrite and gypsum within the underlying Weald Clay Formation may cause aggressive ground conditions impacting foundation design and construction.                                                                                                                                                  |
| Shallow Groundwater                               | Unlikely - Likely   | The presence of shallow groundwater is considered to be unlikely within the Weald Clay Formation, though pockets of perched run-off may be present within more permeable parts. Shallow ground water is considered likely within the superficial deposits on-site and also within the Upper Tunbridge Wells Sand Formation. |
| Potential for shallow soakaways to be unviable    | Low – Likely        | The anticipated cohesive nature of the Weald Clay Formation and shallow parts of the Upper Tunbridge Wells Sand is likely to result in a low probability of soakaways working effectively.                                                                                                                                  |
| Potential for dissolution features                | Negligible          | Soluble or prone to dissolution rocks are not thought to be present beneath the site                                                                                                                                                                                                                                        |
| Potential for slope stability issues              | Very Low - Low      | Slope stability problems are not likely to occur in the majority of site. Slope instability problems may be present or anticipated in the northeast, northwest and southern extremes of the site, or where large cuttings and deep excavations are proposed.                                                                |

**Table 2.1 Possible Geotechnical Hazards**

#### 2.1.2 Preliminary Environmental Conceptual Site Model & Risk Assessment

Based on the desk study the following preliminary Environmental CSM and risk assessment was derived.



| Potential Source/media                                                                              | Potential Receptors          | Potential Pathways           | Likelihood | Severity | Risk and Justification                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------|------------------------------|------------------------------|------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Made Ground and Shallow Soils (Including Deposits Associated with Neighbouring Railway Line)</b> | End users                    | Direct Contact, Inhalation   | Likely     | Mild     | <b>Moderate to Low</b><br>Future users are likely to come into contact with soils via direct contact within gardens and soft landscaping or tracked back into the building. Soils must be of suitable chemical and physical quality for the proposed end use. |
|                                                                                                     | Soft Landscaping             | Root Uptake                  | Likely     | Mild     | <b>Moderate to Low</b><br>Soft landscaping is likely to be included within the proposed development. Any imported soils must be of suitable chemical and physical quality for the proposed end use.                                                           |
|                                                                                                     | Adjacent land users          | Direct Contact, Inhalation   | Unlikely   | Minor    | <b>Very Low</b><br>Adjacent site users are unlikely to come into contact with and affected soils on site. Additionally, natural soils are not anticipated to represent a risk of harm to human health.                                                        |
|                                                                                                     | Water supply pipes           | Chemical Attack              | Likely     | Mild     | <b>Moderate to Low</b><br>Water supply pipes are likely to be placed in natural soils however, locally deeper areas of Made Ground may be present.                                                                                                            |
|                                                                                                     | Buildings and infrastructure | Chemical Attack              | Likely     | Minor    | <b>Low</b><br>Foundations and utilities will be placed within natural soils. however, locally deeper areas of Made Ground may be present.                                                                                                                     |
|                                                                                                     | Groundwater                  | Vertical & Lateral Migration | Likely     | Minor    | <b>Low</b><br>The Superficial deposits and Upper Tunbridge Wells Sand Formation beneath the site are classified as Secondary A aquifers. However, the Weald Clay Formation which is                                                                           |



| Potential Source/media                                                                               | Potential Receptors            | Potential Pathways | Likelihood | Severity | Risk and Justification                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------|--------------------------------|--------------------|------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                      |                                |                    |            |          | beneath the majority of the site is classified as unproductive strata.                                                                                                                                                            |
| Naturally Occurring Chemical Ground Conditions That Could Affect End Users or Construction Materials | End users                      | Direct Contact     | Unlikely   | Minor    | <b>Very Low</b><br>Future users are unlikely to come into contact with natural soils beneath the site. No naturally occurring chemical conditions are likely to present harm to end users                                         |
|                                                                                                      | Water supply pipes             | Chemical Attack    | Unlikely   | Minor    | <b>Very Low</b><br>Water supply pipes are likely to be placed in natural soils and are unlikely to be affected by any natural ground conditions that could affect water pipe materials.                                           |
|                                                                                                      | Buildings and infra- structure | Chemical Attack    | Likely     | Mild     | <b>Moderate to Low</b><br>The Weald Clay Formation may contain elevated concentrations of sulphate, pyrite and gypsum. The concrete design may need to be sulphate resisting.                                                     |
| Ground Gases/Vapours                                                                                 | End Users                      | Inhalation         | Unlikely   | Medium   | <b>Low</b><br>Significant volumes of putrescible material or high concentrations of VOCs from hydrocarbon contamination would be necessary in any Made Ground for significant ground gas production, and this is not anticipated. |
|                                                                                                      | Adjacent land users            | Inhalation         | Unlikely   | Minor    | <b>Very Low</b><br>Adjacent site users are unlikely to be adversely affected by ground gases originating on the site.                                                                                                             |
|                                                                                                      | Soft Landscaping               | Root Uptake        | Unlikely   | Minor    | <b>Very Low</b><br>Soft landscaping is not expected to be adversely affected by any ground gases.                                                                                                                                 |
|                                                                                                      | Buildings and infrastructure   | Gas Accumulation   | Unlikely   | Minor    | <b>Very Low</b>                                                                                                                                                                                                                   |



| Potential Source/media | Potential Receptors | Potential Pathways                         | Likelihood | Severity | Risk and Justification                                                                                                                                                                                        |
|------------------------|---------------------|--------------------------------------------|------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        |                     | and Potential Explosion of Flammable Gases |            |          | Extensive putrescible material would be necessary in any Made Ground for significant ground gas production, and this is not anticipated. Ground gases are unlikely to affect integrity of building materials. |

Table 2.2 Preliminary Risk Assessment and CSM



### 2.1.3 Preliminary Risk Assessment Summary

The PRA and CSM developed from the information gathered as part of the desk study process identified plausible potential pollutant linkages that exist in relation to the proposed redevelopment of the site.

The potential pollutant linkages established within this desk study are not considered to prevent development on the subject site but could 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.

It is considered that the overall risk from potential contamination on site is 'low' albeit with specific potential pollutant linkages being assigned a moderate risk rating and that further assessment would be necessary to satisfy planning conditions or to provide clarification of the risk assessment.

In order to progress this assessment in line with the National Planning Policy Framework, to provide further characterisation of the site and refinement of the PRA and CSM, it is recommended that intrusive investigation and associated testing is 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 is recommended that geochemical and geotechnical investigation be carried out and should include analysis of soil and groundwater (if encountered) samples for the range of potential contaminants identified within the Desk Study, together with ground gas monitoring and an assessment of the sites ground gas climate.



### 3.0 GROUND INVESTIGATION SCOPE & RATIONALE

The following sections detail the scope and rationale of the most recent ground investigation undertaken in May and June 2022.

#### 3.1 Investigation Scope

The scope of works for the investigation included:

- 98No. window sampler boreholes to a maximum depth of 4m bgl or maximum achievable depth with in-situ testing and regular sampling.
- The installation of ground gas and groundwater monitoring wells with six return monitoring visits to be undertaken at fortnightly intervals.
- 71No. machine excavated trial pits to a maximum depth of 3.0m bgl or maximum achievable depth with in-situ testing and regular sampling.
- 49No. machine excavated trial pits to a maximum depth of 0.5m bgl with in-situ testing and sampling.
- Undertake 5No. cable percussion boreholes to a depth of 15m bgl or maximum achievable depth with in-situ testing and sampling at regular intervals.
- Undertake indicative falling head soakage tests within a selection of window sampler boreholes.
- Ground gas and groundwater monitoring (spot monitoring) of well installations on 6 occasions at fortnightly intervals. Wherever possible, the monitoring would target periods of low or rapidly falling atmospheric pressure.
- Geotechnical laboratory testing on soil samples recovered from the exploratory holes to support the geotechnical assessment.
- Geochemical laboratory testing on near surface soils for a suite of commonly occurring brownfield contaminants (including asbestos screening of all samples). Additional targeted geochemical testing for pesticides on samples from within the fields.
- Provision of a Ground Investigation Report detailing; the ground and groundwater conditions encountered; the results of in-situ and laboratory testing; a geotechnical assessment for foundations, drainage, pavement and buried concrete; contamination assessment and recommendations for further action (if required).

It should be noted that locations within cropped fields were within tram lines and immediately adjacent areas outside of the crops in order to minimise damage. In addition, trial pits within the paddocks located within the north-western portion were restricted to access tracks only. The exploratory hole locations are presented in Figure 2. In addition, Figure 2a to 2f show the hole locations for each investigation technique.

It should be noted that due to the density of the siltstone within the Weald Clay and Tunbridge Wells Sand at depth, the cable percussion boreholes terminated prematurely. A contingency had been allowed for the possibility that the deeper boreholes may require rotary coring. A rotary rig was subsequently mobilised to site to drill five boreholes to a depth of 15m.

#### 3.2 Investigation Rationale

The following tables summarise the strategy of the environmental (Table 3.1) and geotechnical (Table 3.2) investigations.



| Environmental Area of Concern    | Investigation                                                                                                  | Positions                                                                                                                                                                                                                      |
|----------------------------------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topsoil and Possible Made Ground | Window Sampler boreholes and trial pits situated across the site with regular sampling and laboratory analysis | All WSs & TPs                                                                                                                                                                                                                  |
| Ground Gas and Vapours           | Newly installed standpipes within the window sampler boreholes.                                                | WS04, WS05, WS40, WS39, WS03, WS20, WS76, WS92, WS36, WS43, WS01, WS16, WS24, WS78, WS12, WS37, WS28, WS34, WS06, WS45, WS53, WS48, WS08, WS60, WS72, WS87, WS68, WS69, WS09, WS52, WS65, WS71, WS90, WS70, WS13, BH103, BH102 |

Table 3.1 Summary of Environmental Investigation Strategy

| Geotechnical Area of Concern                                          | Investigation                                                                                                             | Positions                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lateral changes in ground conditions                                  | Boreholes and trial pits undertaken with regular in-situ testing and sampling.                                            | All locations                                                                                                                                                                                                                  |
| Shrinkable soils                                                      | Boreholes and trial pits undertaken with regular in-situ testing and sampling.                                            | All locations                                                                                                                                                                                                                  |
| High groundwater table and/or flooding (including waterlogged ground) | Newly installed standpipes installed within boreholes and groundwater observations made within all holes during drilling. | WS04, WS05, WS40, WS39, WS03, WS20, WS76, WS92, WS36, WS43, WS01, WS16, WS24, WS78, WS12, WS37, WS28, WS34, WS06, WS45, WS53, WS48, WS08, WS60, WS72, WS87, WS68, WS69, WS09, WS52, WS65, WS71, WS90, WS70, WS13, BH103, BH102 |
| Significant depths of Made Ground                                     | Boreholes and trial pits undertaken with regular in-situ testing and sampling.                                            | All locations                                                                                                                                                                                                                  |
| Aggressive chemical ground conditions (sulphates)                     | Boreholes and trial pits undertaken with regular in-situ testing and sampling.                                            | All locations                                                                                                                                                                                                                  |
| Infiltration testing                                                  | Indicative falling head soakage testing undertaken in a selection of window sampler boreholes across the site.            | WS22, WS26, WS27, WS29, WS35, WS47, WS50, WS54, WS55, WS62, WS64, WS74, WS88, WS91, WS93                                                                                                                                       |
| Earth Works Specification                                             | Bulk samples taken from a selection of trial pits across the site.                                                        | TP07, TP12, TP19, TP20, TP22, TP25, TP26, TP31, TP69, TP36, TP44, TP54, TP39, TP42, TP46, TP62, TP65                                                                                                                           |
| Deep Foundations                                                      | Rotary boreholes with in-situ testing and geotechnical testing.                                                           | BH101-BH104                                                                                                                                                                                                                    |

Table 3.2 Summary of Geotechnical Investigation Strategy



## 4.0 ENCOUNTERED CONDITIONS

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

For further details of the encountered ground conditions, reference should be made to the engineer's logs and inferred geological sections presented in Appendix A, the groundwater/gas monitoring assessment presented in Appendix B, the geotechnical testing results in Appendix C, and the chemical testing results in Appendix D.

### 4.1 Ground Conditions

Published geological records and the previous investigation indicated that the ground conditions were likely to comprise Arun Terrace Deposits within isolated pockets within the southern portion, Alluvium within the locations of the Brook and ditches, all overlying the Weald Clay Formation or the Tunbridge Wells Sand within the southernmost portion. A band of Horsham Stone was likely to be present at surface within the northern portion of the site. During the site investigation, no soils resembling the Arun Terrace Deposits, Alluvium or Horsham Stone Member were observed at the borehole and trial pit locations at shallow depth.

A generalised summary of the encountered ground conditions is presented in the following tables.

| Top<br>(m bgl) | Base<br>(m bgl) | Geology                                                                                                                                                                                                                                                                                         | Positions                                                                                                        |
|----------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| 0.00           | 0.10 - 0.30     | <b>TOPSOIL:</b> stiff brown and light brown silty CLAY and silty, sandy, slightly gravelly CLAY with abundant roots and rare roots 1-5mm in diameter and rare brick fragments.                                                                                                                  | TP01-TP03, TP05-TP06, TP08-TP10, TP14-TP16, WS15, WS17-WS19                                                      |
| 0.00           | 0.30            | <b>MADE GROUND:</b> Brown sandy clay and sandy gravelly clay with occasional brick fragments.                                                                                                                                                                                                   | WS13, WS16                                                                                                       |
| 0.20-2.80      | 0.40-3.00       | <b>TUNBRIDGE WELLS SAND:</b> Very stiff light brown, orange brown silty CLAY, silty slightly sandy CLAY, sandy clayey SANDSTONE and silty clayey IRONSTONE/SANDSTONE. With occasional rootlets, black ferruginous inclusions, black staining and gravels of siltstone, sandstone and ironstone. | TP01, TP02, TP03, TP05, TP06, TP08, TP09, TP14, TP15, TP16, WS13, WS15, WS16, WS17, WS18, WS19, WS21, WS24, WS29 |

**Table 4.1 Summary of Ground Conditions (Tunbridge Wells Sand Formation)**

| Top<br>(m bgl) | Base<br>(m bgl) | Geology                                                                                                                                                                        | Positions                                                                                                                                            |
|----------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.00           | 0.10 - 0.40     | <b>TOPSOIL:</b> stiff brown and light brown silty CLAY and silty, sandy, slightly gravelly CLAY with abundant roots and rare roots 1-5mm in diameter and rare brick fragments. | ALL with the exception of TP01-TP03, TP05-TP06, TP08-TP10, TP14-TP16, WS15, WS17-WS19, TP56, WS04, WS13, WS16, WS24, WS36, WS42, WS90, WS91 and WS93 |
| 0.00-0.2       | 0.20 - 0.80     | <b>MADE GROUND:</b> Brown and orange brown silty clay, silty sandy clay and sandy gravelly clay with brick fragments, localized coarse shingle tile fragments and              | TP56, WS04, WS24, WS36, WS42, WS90, WS91 and WS93                                                                                                    |



|             |            |                                                                                                                                                                                                            |                                                                            |
|-------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
|             |            | decomposed organic material, decomposed rootlets and roots.                                                                                                                                                |                                                                            |
| 0.10 – 0.80 | 0.30-5.05  | <b>WEALD CLAY:</b> Stiff to very stiff light brown, brown, orange brown, pale grey stiff to very stiff light brown to pale grey silty/sandy silty CLAY with some weakly cemented silt and siltstone bands. | All with the exception of the those listed under the Tunbridge Wells Sand. |
| 0.30-5.05   | 1.90-15.02 | <b>WEALD CLAY:</b> Brown, orange brown and pale grey laminated, very weak to weak SILTSTONE.                                                                                                               | BH01-BH03, BH101-BH104                                                     |

**Table 4.2 Summary of Ground Conditions (Weald Clay)**

Refusals were recorded within both the trial pits (8 of 71 refused) and window sampler boreholes (87 of 98 refused) at depths of between 1.40m and 3.90m bgl with the holes terminating on impenetrable siltstone.

For more detailed descriptions of the ground conditions at specific locations, reference should be made to the exploratory hole logs and sections presented in Appendix B. In addition, Figure 5 shows the position of exploratory holes where Made Ground was recorded.

## 4.2 Groundwater

During the investigation, groundwater was encountered within WS08, WS12, WS14, WS23, WS31, WS33, WS35, WS37, WS39, WS40, WS44, WS79, WS91, WS92, WS95, TP27, BH101 and BH104 at depths of between 0.87m and 12.60m bgl. After twenty minutes, standing water depths were between 2.20m bgl to 2.90m bgl. Seepages were slow from within the Tunbridge Wells Sand Formation and Weald Clay Formation at depth. Overall, the depth of groundwater strikes was between 0.87m and 3.85m bgl. The following table summarises the groundwater encountered:

| Location                | Strike Depth (m bgl) | Depth after 20 Minutes (m bgl) | Depth on Completion of Drilling (m bgl) |
|-------------------------|----------------------|--------------------------------|-----------------------------------------|
| WS08 (520075E-133825N)  | 2.50                 | 1.65                           | 1.65                                    |
| WS12 (519695E-133559N)  | 2.16                 | 2.16                           | 2.16                                    |
| WS14 (520158E-133590N)  | 3.00                 | 1.89                           | 1.89                                    |
| WS23 (519758E-133340N)  | 3.00                 | 1.29                           | 1.29                                    |
| WS31 (519700E-133525N)  | 2.24                 | 2.24                           | 2.24                                    |
| WS33 (519420E-133563N)  | 2.69                 | 2.69                           | 2.69                                    |
| WS35 (519777E-133568N)  | 1.20                 | 1.90                           | 1.90                                    |
| WS37 (519963E-133585N)  | 2.80                 | 0.78                           | 0.78                                    |
| WS39 (519325E-133600N)  | 0.87                 | 0.87                           | 0.87                                    |
| WS40 (519475E-133600N)  | 2.78                 | 2.78                           | 2.78                                    |
| WS44 (520113E-133713N)  | 2.30                 | 2.30                           | 2.30                                    |
| WS79 (520075E-134125N)  | 1.30                 | 1.65                           | 1.65                                    |
| WS91 (519474E-134349N)  | 3.26                 | 3.26                           | 3.26                                    |
| WS92 (519589E-133413N)  | 1.94                 | 1.94                           | 1.94                                    |
| WS95 (519565E-134277N)  | 2.60                 | 2.05                           | 2.05                                    |
| TP27 (520317E-133575N)  | 3.00                 | 2.90                           | -                                       |
| BH101 (519391E-133429N) | 12.50                | -2.20 (artesian)               | Sealed Out                              |
| BH102 (519623E-133489N) | Dry                  | Dry                            | -                                       |
| BH103 (519385E-133737N) | Dry                  | Dry                            | -                                       |
| BH104 (519882E-133407N) | 8.50                 | -0.80 (Artesian)               | Sealed Out                              |

**Table 4.2: Intrusive Investigation Groundwater**



It is important to note that in addition to the groundwater strikes noted above, two artesian water strikes were recorded in BH101 and BH104 at depths of 12.50m bg and 8.50m respectively. The boreholes encountered artesian water pressure within the siltstone at depth, which consequently resulted in the water rising to a steady head of between 2.20m and 0.80m above ground level within the drilling casing in BH101 and BH104 respectively. The water flows were eventually sealed out using a bentonite plug within each borehole. The locations of the rotary cored boreholes where artesian strikes were recorded is shown on Figure 6.

Six monitoring visits have been undertaken. Details of the wells installed and their response zones are presented in table 4.2 below:

| Location ID             | Depth Response Zone Top (m bgl) | Depth Response Zone Base (m bgl) | Response Zone Formation |
|-------------------------|---------------------------------|----------------------------------|-------------------------|
| BH102 (519623E-133489N) | 1.00                            | 15.00                            | Weald Clay              |
| WS01 (519625E-133375N)  | 1.00                            | 2.85                             | Weald Clay              |
| WS03 (519325E-133375N)  | 1.00                            | 2.50                             | Weald Clay              |
| WS04 (519094E-133451N)  | 1.00                            | 2.90                             | Weald Clay              |
| WS05 (519268E-133415N)  | 1.00                            | 2.30                             | Weald Clay              |
| WS06 (520413E-133674N)  | 0.40                            | 2.40                             | Weald Clay              |
| WS08 (520075E-133825N)  | 1.00                            | 4.00                             | Weald Clay              |
| WS09 (519528E-133793N)  | 0.30                            | 2.30                             | Weald Clay              |
| WS12 (519695E-133559N)  | 1.00                            | 2.90                             | Weald Clay              |
| WS13 (520004E-133211N)  | 0.40                            | 2.40                             | Tunbridge Wells Sand    |
| WS16 (519811E-133121N)  | 1.00                            | 2.10                             | Tunbridge Wells Sand    |
| WS20 (519549E-133296N)  | 1.00                            | 2.90                             | Weald Clay              |
| WS24 (520225E-133375N)  | 0.90                            | 2.90                             | Tunbridge Wells Sand    |
| WS34 (520230E-133543N)  | 0.40                            | 1.40                             | Weald Clay              |
| WS36 (519524E-133571N)  | 1.00                            | 3.90                             | Weald Clay              |
| WS37 (519963E-133585N)  | 1.00                            | 2.95                             | Weald Clay              |
| WS39 (519325E-133600N)  | 1.00                            | 4.00                             | Weald Clay              |
| WS40 (519475E-133600N)  | 1.00                            | 2.90                             | Weald Clay              |
| WS43 (519625E-133676N)  | 1.00                            | 3.00                             | Weald Clay              |
| WS45 (520450E-133747N)  | 0.40                            | 2.40                             | Weald Clay              |
| WS48 (520109E-133782N)  | 1.00                            | 3.10                             | Weald Clay              |
| WS52 (519475E-133825N)  | 1.00                            | 2.00                             | Weald Clay              |
| WS60 (520090E-133977N)  | 1.00                            | 2.00                             | Weald Clay              |
| WS65 (519395E-134063N)  | 0.80                            | 2.80                             | Weald Clay              |
| WS68 (519789E-134053N)  | 1.00                            | 2.70                             | Weald Clay              |
| WS69 (520151E-134082N)  | 1.00                            | 2.00                             | Weald Clay              |
| WS70 (519407E-134123N)  | 1.00                            | 3.00                             | Weald Clay              |
| WS71 (519625E-134125N)  | 0.40                            | 2.40                             | Weald Clay              |
| WS72 (520225E-134125N)  | 1.00                            | 2.90                             | Weald Clay              |
| WS76 (519476E-133443N)  | 1.00                            | 2.85                             | Weald Clay              |



|                        |      |      |            |
|------------------------|------|------|------------|
| WS78 (520134E-133525N) | 1.00 | 3.00 | Weald Clay |
| WS85 (519818E-134233N) | 1.00 | 2.00 | Weald Clay |
| WS86 (520161E-134255N) | 0.90 | 2.00 | Weald Clay |
| WS90 (519396E-134349N) | 1.00 | 3.20 | Weald Clay |
| WS92 (519589E-133413N) | 1.00 | 2.90 | Weald Clay |
| WS97 (519683E-134150N) | 0.40 | 2.40 | Weald Clay |

**Table 4.3: Standpipe Details**

During the visits, water levels were recorded at depths of between 0.90m and 2.90m bgl. With the exception of the groundwater levels recorded within BH102 and BH103, water levels are likely to represent accumulations of seepages since. Water within BH102 and BH103 is likely to represent deeper groundwater within the siltstone at depth.

Standpipes were originally programmed to be installed within BH101 and BH104, however, due to encountering water under artesian pressure, these were not installed.

It is recommended that a pilot hole is drilled using rotary techniques immediately adjacent to any deep excavations prior to construction, to investigate the potential for artesian groundwater within the depth of the proposed excavation.

### 4.3 Ground Gases

Dual purpose gas and water monitoring standpipes were installed within WS04, WS05, WS40, WS39, WS03, WS20, WS76, WS92, WS36, WS43, WS01, WS16, WS24, WS78, WS12, WS37, WS28, WS34, WS06, WS45, WS53, WS48, WS08, WS60, WS72, WS87, WS68, WS69, WS09, WS52, WS65, WS71, WS90, WS70, WS13, BH103, BH102 at depths of between 1.40m and 15.00m bgl. Methane has been recorded within the range of 0.0% v/v and 0.5% v/v, whilst carbon dioxide and oxygen have been recorded within the range of <0.1% v/v to 5.7% v/v (WS40) and 14.1% v/v to 21.6% v/v respectively. The highest gas concentrations were recorded within WS40 within the easternmost corner of the sports pitches site area. All other carbon dioxide concentrations within the other wells have been low and less than 5%. It should be noted that the elevated concentrations of CO<sub>2</sub> within WS40 (up to 5.7% v/v) were only recorded during the first three visits. Visits four to six recorded concentrations of CO<sub>2</sub> below 5%.

A maximum VOC concentration of 2.3ppm has been recorded, whilst atmospheric pressure has been recorded within the range of 1006mb to 1020mb. Flows have been recorded within the range of <0.1/hr and 0.2/hr. For further details, reference should be made to the ground gas assessment sheet in Appendix C.

### 4.4 Obstructions

No artificial obstructions were encountered during the investigation. However, all cable percussion boreholes, the majority of window sampler boreholes and a small number of trial pits refused prematurely within dense natural soils (siltstones). There remains the potential for buried artificial obstructions, with the greatest risk beneath the footprint of former structures once demolition has been undertaken.

### 4.5 Geochemical Analysis

In order to assess the general chemical quality of the strata encountered, samples of soils recovered from the exploratory holes were submitted for analysis for a range of potential contaminants selected on the basis of the findings of the desk study and supported by the joint National House Building Council (NHBC), Environment



Agency (EA) and Chartered Institute of Environmental Health (CIEH) publication, 'Guidance for the Safe Development of Housing on Land Affected by Contamination' (2008).

Soil samples were placed into plastic containers for general inorganic analysis and into amber jars for organic analysis. 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 the laboratory's protocols.

138No. soil samples were submitted for analysis for a comprehensive suite of common zootoxic and phytotoxic elements based upon determinants listed within the above guidance. In addition, 23No. samples were scheduled for pesticide screening and 20No. samples for petrol and diesel ranges to augment the waste disposal assessment. The locations of the samples submitted for chemical testing are shown on Figure 7.

Full details of the laboratory test results are presented in Appendix E.

#### 4.6 Geotechnical Analysis

The results of geotechnical testing undertaken as part of the ground investigation are summarised in Tables 4.4 and 4.5 with test results presented in Appendix D. Appendix D also includes Table 4.6, which summarises all the Atterberg Limit test results and has columns for both the volume change potential and modified volume change potential.

| Parameter                                         | Tunbridge Wells Sand Formation |
|---------------------------------------------------|--------------------------------|
| pH                                                | 5.3-6.8                        |
| Water soluble sulphate (g/l)                      | 0.02-0.03                      |
| Natural Moisture Content (%)                      | 12-23                          |
| Liquid Limit (%)                                  | 26-46                          |
| Plastic Limit (%)                                 | 14-24                          |
| Plasticity Indices (%)                            | 12-24                          |
| Modified Plasticity Indices (%)                   | 7-23                           |
| Particle Size Distribution Fines <0.063mm (%)     | 20.7-82.5                      |
| Pocket Penetrometer Results (kg/cm <sup>2</sup> ) | 0.7-6.5                        |

**Table 4.4: Summary of Geotechnical Laboratory Test Results (Tunbridge Wells Sand Formation)**

| Parameter                                         | Weald Clay Formation |
|---------------------------------------------------|----------------------|
| pH                                                | 5.0-7.6              |
| Water soluble sulphate (g/l)                      | 0.01-0.08            |
| Natural Moisture Content (%)                      | 8.7-34               |
| Liquid Limit (%)                                  | 26-79                |
| Plastic Limit (%)                                 | 14-32                |
| Plasticity Indices (%)                            | 11-53                |
| Modified Plasticity Indices (%)                   | 0.9-43               |
| Particle Size Distribution Fines <0.063mm (%)     | 32.1                 |
| SPT 'N' Values                                    | 8-65                 |
| Unconfined Compressive Strength MPa               | 0.54-33              |
| Point Load Test (Is (50))                         | 0.01-2.38            |
| Pocket Penetrometer Results (kg/cm <sup>2</sup> ) | 0.8-5.0              |
| BS Light Compaction Test                          |                      |
| Maximum Dry Density (Mg/m <sup>3</sup> )          | 1.48-1.89            |



|                              |       |
|------------------------------|-------|
| Optimum Moisture Content (%) | 15-25 |
|------------------------------|-------|

**Table 4.5: Summary of Geotechnical Laboratory Test Results (Weald Clay Formation)**



## 5.0 ENGINEERING CONSIDERATIONS

Subsequent to intrusive investigation of the site and receipt of the laboratory results, the following interpretative assessments have been made with respect to engineering considerations.

### 5.1 Foundations

Based on the ground and groundwater conditions encountered in the boreholes and trial pits, conventional foundations are considered suitable for the proposed development remote from the influence of trees.

For the commercial part of the development, although not strictly applicable to the form of construction, it is recommended that the NHBC Standards be followed when designing foundation depths and heave precautions near trees.

The results of the Atterberg Limit tests classified the soils of the Weald Clay Formation as ranging between low and high-volume change potential and the results for the Upper Tunbridge Wells Sand ranged between low and medium volume change potential in accordance with the NHBC Standards, Chapter 4.2. The majority of modified volume change results were classified as medium volume change potential although in the central and eastern parts of the site there was an area where the soils were found to be low volume potential. The approximate area is shaded on Figure 8. Within the area shaded on Figure 8, it may be possible to design foundations in accordance with low volume change potential subject to further confirmatory testing. The modified volume change potentials for each Atterberg Test are summarised on Figure 8.

It is recommended that in lieu of any further investigation the Weald Clay and Upper Tunbridge Well Sand Formations be classified *en masse* as Medium Volume Change Potential in accordance with the NHBC Standards, Chapter 4.2. A minimum founding depth within the Weald Clay and Upper Tunbridge Wells Sand Formations of 0.90m is therefore applicable remote from trees. Foundations should not be less than 450mm in width.

Within the zone of moisture demand of any existing, proposed or recently felled trees it is recommended that foundation depths be calculated in accordance with the NHBC Standards, Chapter 4.2. Foundations should also be taken through any major root zone and desiccated clay soils should this be found at greater depth. It should be noted that the NHBC stipulate that foundations cast at depths greater than 2.5m should be “engineer designed”.

Where calculated foundation depths are in excess of 1.50m on account of trees, heave protection measures should be detailed in accordance with the NHBC Standards, Chapter 4.2.

Based on the results of in-situ tests and typical settlement parameters for the types of soil encountered, a maximum allowable bearing capacity of 150kPa is applicable for trench, strip or isolated pad foundations up to 1.50m in width taken through any Made Ground, soft or loose zones, desiccated or disturbed soils and placed wholly into or onto the stiff silty clays of the Weald Clay or Upper Tunbridge Wells Sand Formations. Under this loading settlements should remain within tolerable limits for the proposed construction.

Given the cohesive nature of the Weald Clay and Upper Tunbridge Wells Sand Formations, these materials will soften rapidly when exposed to free water, and foundations should be concreted, blinded, or otherwise protected, immediately after excavation.

Where foundation depths are calculated to exceed 2.5m on account of trees or for any highly loaded structures such as bridge abutments a piled foundation solution may be more appropriate.



## 5.2 Piled Foundations

It is possible that piled foundations may be required on parts of the site due to the presence of trees and shrinkable soils or due to potential high foundation loading. The construction of a piled foundation is a specialist job and the advice of a reputable local contractor familiar with the type of ground and groundwater conditions encountered on this site should be sought prior to finalising the design.

For preliminary purposes, assuming a rock socket pile of 450mm diameter socketing a depth of 2.25m into the very weak to weak siltstone and further assuming zero contribution to skin friction above the socketed depth, a preliminary working load of **1,945kN** has been calculated using a factor of safety of 3.0 on both end bearing and skin friction.

The bearing value given are applicable to single vertically loaded piles. Where groups of piles are to be constructed, the bearing value of each individual pile should be reduced by a factor of 0.8 and a calculation made to check for the factor of safety against block failure.

The contractor should be advised on the potential for artesian groundwater conditions to be encountered as found in BH101 and BH104 and that this might be encountered at a shallower depth on other parts of the site.

## 5.3 Pumping Stations

It is understood that a pumping station pumping stations are to be constructed with the bases at a depth of circa 10mbgl. The ground conditions generally comprised firm to very stiff orange brown, brown and light brown sandy silty clay and sandy gravelly silty clay. At depth, the Weald Clay Formation became extremely weak, very weak and weak grey laminated siltstone.

Pumping stations are usually constructed by means of sinking a shaft. It is unlikely to be feasible, due to the depth (10m), to construct the pumping station by means of an excavation with temporary slopes cut to a short-term safe angles of repose. Therefore, it is likely that a contiguous, secant or sheet piled retaining wall will be required, though due to the density of the siltstone at depth the advice of a specialist contractor should be sought regarding the 'driveability' of sheet piles or use of contiguous/secant bored piles.

The excavation process for the pumping stations will result in some ground movement due to the changes in vertical stress within the soil resulting from the changes in loading.

The effect of excavating soil is to cause a reduction in stress at the new formation level, due to the weight of the overburden removed. Since typically, construction follows on shortly after excavation, this unloading of the ground is normally modelled as producing a short term (undrained) response. However, if there is a delay in the construction phase, a fully drained response to the unloading may develop. In the case of the proposed development, it is assumed that construction of the pumping station shaft will be quickly followed by construction and hence modelling an undrained response is applicable.

The loading that results from the new construction will apply in the long term, over the structure's lifetime. Hence there will be both a short term and long term response. Generally, the long term behaviour results in larger movements. The overall movement of the ground following construction is, however, driven by the total changes in loading that have occurred; thus it is a combination of the unloading caused by excavation of soil and the imposed loading from the new structure.

The ground response to stress changes have therefore been modelled in the short term for the unloading caused by excavation and removal of overburden pressure. The long term response has been modelled for the



estimated net stress change as a result of the excavation and new loading. Details of the loads from the pumping stations are yet to be finalised, but provisionally a loading of 50kPa has been assumed for the purposes of this preliminary calculation.

The OASYS Software PDISP (V20) has been used to model the ground movements associated with the changes in stress calculated for the pumping station excavation and subsequent development. PDISP assumes a linear elastic behaviour of the soil and a flexible structure. In reality, the stiffness of the structures will tend to redistribute the movements, when compared to those predicted by PDISP. The movement calculations therefore represent free field movements unaffected by the stiffness of the structures and are likely to be conservative (i.e. the distortions of the structure would be less than those obtained from the predicted movements).

The assessments were undertaken using soil parameters (undrained and drained) derived from the ground investigation to model the stiffness behaviour. A rigid base for the analysis was taken as –20mbgl. The PDISP outputs denote upward movements (heave) where the number prefixed by a minus sign. Results without any prefix denote downward movements (settlement).

It was estimated that the stress relief due to net unloading at the centre of the pumping stations shaft would be approximately 200kPa for which a short-term heave of 2-3 mm occurring within the centre of the excavation has been calculated.

It should be noted that the values of heave given do not take into account any restraining effect from the retaining walls of the shaft. The movements of the ground following construction were also analysed for the long term (drained) case after the completion of the structure. The PDISP analyses estimated long term heave movements of between 4-5mm at the centre of the shafts. It is reiterated that these movements are the theoretical movements and are unlikely to be realised in practice due to the restraining effects of the structure.

Provision should be made to accommodate hydrostatic forces (buoyancy) and to this end it is recommended that a groundwater level of <1.0m is considered. During the drilling of the boreholes artesian groundwater was struck in BH101 at a depth of 12.50m bgl rising to 2.2m above ground level. BH102 remained dry throughout the drilling process. Groundwater under artesian pressure may be encountered at a shallower depth on other parts of the site.

It is anticipated that perched groundwater bodies will be present within the more permeable less cohesive horizons with the potential for artesian groundwater present within the weakly cemented Siltstone at depth. Consideration will therefore need to be given to the failure of the base of the excavation by uplift or heave. The actions of the foundations alone are unlikely to be sufficient and some form of anchorage such as tension piles are likely to be required.

#### **5.4 Bridge Abutments & Culverts**

For the proposed brook crossings, the foundations for the box culverts should be taken through any potential Alluvium (localised within the brook) and soft soils and to a moisture stable depth, into or onto the stiff Weald Clay or Upper Tunbridge Wells Sand. Whilst an allowable bearing pressure of 150kPa is applicable within the natural clay soils, should foundations be taken into or onto the weak siltstones at depth, an allowable bearing pressure of 300kPa may be adopted and should maintain total settlements below 30mm for a 5m x 5m foundation.



## 5.5 Excavations

Shallow excavations within the Weald Clay Formation and Tunbridge Wells Sand Formation across the site are likely to remain relatively stable in the short term. However, longer deeper excavations any granular horizons within the Weald Clay Formation may be prone to instability and some form of temporary support or battering back to a safe angle may be required.

In addition, the clays of the Weald Clay Formation and Tunbridge Wells Sand Formation will soften rapidly when exposed to water. Therefore, foundation trenches should be concreted or blinded immediately upon excavation.

All excavations intercepting the groundwater table, should it be encountered, will become highly unstable and some form of temporary support and heavy dewatering may be required. Where excavations intercept groundwater under artesian pressure significant construction difficulties will occur together with potential rapid surface flooding. The groundworks contractor should be made aware of the potential to intercept artesian groundwater at depth and should provide a contingency to seal the flow of water and mitigate potential surface flooding if encountered.

It is recommended that a pilot hole is drilled using rotary techniques immediately adjacent to any deep excavations prior to construction, to investigate the potential for artesian groundwater within the depth of the proposed excavation.

Ground works should always be designed in such a manner to avoid man entry into excavations. However, in the event that such works cannot be avoided or designed out, they should only be undertaken in accordance with a safe system of work, following an appropriate risk assessment and in accordance with any legislative requirements, e.g. Confined Spaces Regulations.

## 5.6 Floor Slabs

Based on the laboratory testing results and the presence of trees and shrinkable soils, suspended ground floor slabs should be utilised.

## 5.7 Preliminary Earth Works Criteria

There will be a requirement for reprofiling the wider site to accommodate infra-structure and provide development platforms etc. Specifically, on the south-western portion of the site there are plans to construct sports pitches and a road embankment sloping down from the existing A264 to accommodate the junction and the proposed ring road.

Geotechnical laboratory testing was therefore undertaken over the wider site on samples that are likely to be representative of the proposed earthworks cut or fill materials as identified on site for preliminary design purposes. A summary of the results is presented in Table 5.7.

| Property                   | Results             |
|----------------------------|---------------------|
|                            | Range               |
| Classification             | Class 2A – Class 2B |
| Plastic Limit (%)          | 14-32               |
| Plasticity Index           | 11-53               |
| Moisture content (%)       | 8.7-34%             |
| Optimum Moisture Content % | 15-23%              |



|                     |                             |
|---------------------|-----------------------------|
| Maximum dry density | 1.48-1.89 Mg/m <sup>3</sup> |
|---------------------|-----------------------------|

**Table 5.7 Summary of Geotechnical Testing Results****5.7.1 Preliminary Earthworks Materials Classification**

It is likely that the vast majority of the site wide soils to be won as earthworks will be classified as Class 2A of Specification for Highway Works (SHW) 600 Series. However, some Class 2B and Class 2C material is also likely to be generated. The results have shown the samples to exhibit soil moisture contents marginally on the wet side of the likely acceptability criteria, thus the control of moisture content is likely to be critical in achieving the required compaction. It is probable that some treatment will be required prior to placement and compaction, i.e. setting the overly wet soil aside to dry out and will require additional testing to demonstrate that the soils meet the acceptability criteria set out in any specific Earthworks Specification.

It is anticipated that works would commence with stripping of Topsoil present across the site and setting aside in segregated stockpiles for potential re-use in due course (subject to results of suitability testing). The cut and fill earthworks would then progress, with excavated soils set aside in stockpiles for temporary storage or moved directly to areas requiring fill for placement and compaction.

Given the presence of some clay horizons with high siltstone and siltstone gravel content, it is anticipated that the materials will require segregation and careful management during the excavation.

Where soils are found to contain significant volumes of siltstone or fragments, these could be set aside for non engineered fill areas, where post compaction swelling or heave are not of concern.

On the basis of the testing undertaken to date, it is considered that key criteria to verify compliance during the earthworks would be moisture content, as determined by sampling and laboratory testing of soils from the stockpiled material immediately prior to use and/or sampling immediately post placement.

If material is used as an engineered fill to raise ground levels, it would not be suitable as a bearing stratum for building foundations and the foundations would need to pass through the fill material to bear upon either the Tunbridge Wells Sand or Weald Clay.

**5.8 Retaining Wall Design**

The full design of any proposed retaining structures was beyond the scope of the report. However, the following values are given as a guide to assist in the design of retaining walls. These parameters assume a level surface to the rear of the retaining wall. The values have been obtained from British Standard 8002:2015 entitled "Earth Retaining Structures", based on the encountered strata and a concrete retaining wall construction.

Table 5.8 summarises relevant geotechnical values recommended for the potential retaining structure(s).

| Parameter                                                  | Clay of the Tunbridge Wells Sand | Clay of the Weald Clay | Siltstone of the Weald Clay |
|------------------------------------------------------------|----------------------------------|------------------------|-----------------------------|
|                                                            | Value                            | Value                  | Value                       |
| Critical state angle of shearing resistance ( $\phi'$ )°   | 27                               | 25                     | 30                          |
| Effective Cohesion kN/m <sup>2</sup>                       | 0                                | 0                      | 0                           |
| Saturated Bulk Weight ( $\gamma_{sat}$ ) kN/m <sup>3</sup> | 19                               | 19                     | 20                          |

**Table 5.8 Geotechnical parameters for retaining wall design in Cohesive Soils & Rock**



## 5.9 Pavements

Made Ground was encountered in very limited areas and, where found, the Made Ground was noted to be of mixed composition and of limited thickness. The engineering characteristics of such soils are variable and unpredictable and the CBR value of Made Ground does not predict the overall settlements that may occur in such materials. Due to the heterogeneity of the variable amounts of Made Ground it would be prudent to assume the material to be deemed frost susceptible throughout.

As part of the investigation, disturbed samples were taken at c.0.50m bgl from along the line of the proposed spine road at circa 30m intervals. The samples were then sent for analysis to determine their plasticity indices using four point Atterberg Tests in accordance with BS1377 Part 2 Clause 4.3, 5.0 and 3.2. The plasticity indices for the 49No. tests in this part of the site ranged between 14 and 31. Based on the results a characteristic value of 32 was calculated for the Plasticity Index. This characteristic value was based on the 95% fractile i.e. 95% of the results could be expected to be lower than the selected value.

Based on extrapolation the Transport and Road Research Laboratory Report (LR1132) entitled '*The Structural Design of Bituminous Roads*' (1984) cites an estimated equilibrium suction index CBR of 4.0% for clay soils with a Plasticity Index of 32 for a thin pavement, under average construction conditions and a low groundwater level.

Based on the laboratory results and TRRL report, a CBR value of 4.0% is recommended. However, the design CBR should also take account of West Sussex County Council Standard Detail S278/38/21 specifications where it is proposed for the roads to be adopted.

Based on the geotechnical results, the near surface Weald Clay Formation and Tunbridge Wells Sand Formation should be considered as being non-frost susceptible for pavement design purposes. It is recommended that the sub-grade be proof rolled and any soft spots removed and replaced with a suitable compacted granular fill.

## 5.10 Sulphates

One pH and Sulphate test was undertaken on the Topsoil. The result for the Topsoil corresponded to design class DS-1 as defined within the BRE Special Digest 1 (2005). The pH analyses indicate the ACEC class to be between AC-1s. It is recommended that a design class of DS-1 and an ACEC class of AC-1s be applied to all sub-surface concrete within this stratum.

Six pH and Sulphate tests were undertaken on the Tunbridge Wells Sand Formation. The results for the Tunbridge Wells Sand Formation corresponded to design class DS-1 as defined within the BRE Special Digest 1 (2005). The pH analyses indicate the ACEC class to be AC-1s. It is recommended that a design class of DS-1 and an ACEC class of AC-1s be applied to all sub-surface concrete within this stratum.

Thirty-eight pH and Sulphate tests were undertaken on the Weald Clay Formation (static groundwater). The results for the Weald Clay Formation corresponded to design class DS-1 as defined within the BRE Special Digest 1 (2005). The pH analyses indicate the ACEC class to be between AC-1s. It is recommended that a design class of DS-1 and an ACEC class of AC-1s be applied to all sub-surface concrete within this stratum.

Fourteen pH and Sulphate tests were undertaken on the Weald Clay Formation (mobile groundwater). The results for the Weald Formation corresponded to design classes DS-1 to DS-2 as defined within the BRE Special Digest 1 (2005). The pH analyses indicate the ACEC class to be between AC-1s to AC-3.



According to BRE Special Digest 1 (2005) *“concrete if pyritic ground which is initially low in soluble sulphate does not have to be designed to withstand a high potential sulphate class unless it is exposed to ground which has been disturbed to the extent that contained pyrite might oxidise and the resultant sulphate ions reach the concrete. This may prompt redesign of the structure or change to the construction process to avoid ground disturbance; for example, by using precast or cast-in-situ piles instead of constructing spread footing within an excavation.”*

### 5.11 Soakaways

Sixteen indicative falling head soakage tests were undertaken within WS22, WS26, WS27, WS29, WS35, WS47, WS50, WS54, WS55, WS62, WS64, WS74, WS75, WS88, WS91 and WS93, Infiltration was negligible with very poor results due to the cohesive nature of the Weald Clay Formation and Tunbridge Wells Sand Formation.

The rates from the indicative preliminary falling head tests are as follows:

- WS22 –  $3.8 \times 10^{-8}$  m/s
- WS26 –  $1.8 \times 10^{-8}$  m/s
- WS27 –  $1.1 \times 10^{-8}$  m/s
- WS29 –  $1.2 \times 10^{-9}$  m/s
- WS35 –  $2.7 \times 10^{-8}$  m/s
- WS47 –  $4.4 \times 10^{-9}$  m/s
- WS50 –  $2.2 \times 10^{-9}$  m/s
- WS54 –  $6 \times 10^{-9}$  m/s
- WS55 –  $2 \times 10^{-9}$  m/s
- WS62 –  $1 \times 10^{-9}$  m/s
- WS64 –  $1.6 \times 10^{-8}$  m/s
- WS74 –  $5.6 \times 10^{-8}$  m/s
- WS75 – No rate calculated, no drop in head of water
- WS88 – No rate calculated, no drop in head of water
- WS91 – No rate calculated, no drop in head of water
- WS93 –  $1.8 \times 10^{-9}$  m/s

It is highly unlikely that conventional soakaways will work effectively on this site and it is recommended that an alternative form of drainage be used with regards to the discharge of surface water.

### 5.12 Attenuation Basins

The basins will be in-ground features created by excavation and will have sides slopes of 1(v) in 3(h) (approximately 18°) or shallower. It is recommended that prior to finalising the design a slope stability assessment be undertaken on the basins side slopes to check the stability at the proposed design angle.

Groundwater ‘springs’ are unlikely on the study site at shallow depth, however, where rock bands daylight in slope faces, groundwater seepages may occur. If these are significant, it may be necessary to consider the use of counterfort drains in the slopes to control and direct the seepages off the slope faces.

Depending on the final depth of the basins, excavations may be close to the rock head. However, the basins are unlikely to encounter artesian water at the likely depths of excavation (assumed less than 4.0mbgl). The shallower rock bands are often surrounded by low permeability clays meaning that the groundwater in the rock bands is not likely to be replenished quickly. It is therefore unlikely that the bases of the basins will



experience heave of the ground due to water pressure exceeding the strength of the soils beneath them in this instance. The soakaway testing in the boreholes has confirmed the very low permeability of the Tunbridge Wells Sand and Weald Clay soils on the site and therefore any water seeping through the bases of the ponds is likely occur very slowly in very small quantities and is likely to be easily conveyed away from the pond outlets. However, we recommend that this should be allowed for in the design of any attenuation volumes as a potential contributory base flow.



## 6.0 ENVIRONMENTAL CONSIDERATIONS

A Generic Quantitative Risk Assessment (GQRA) was undertaken on the results of the chemical testing on the soil samples, the findings of which are presented in the following sections.

### 6.1 Environmental Risk Assessment

Based on a visual assessment of the soils encountered, in conjunction with the Desk Study, 138No. soil samples were selected for chemical testing from across the site at depths of between 0.10m and 1.00m bgl. Of those tested, 96No. were of Topsoil, 11No. were of Made Ground, 28No. were of Weald Clay and 3No. were of Tunbridge Wells Sand.

The samples were submitted for a suite of commonly occurring contaminants including metals, metalloids, inorganic compounds, TPH, PAH and asbestos. In addition, 23No. samples were submitted for pesticide screening and 20No. samples for petrol and diesel ranges.

### 6.2 Soil Contamination vs. End Users

The presence of a possible contaminant does not necessarily imply that a site or area is contaminated or that there is any unacceptable risk to human health. A Preliminary Quantitative Risk Assessment has been undertaken in order to evaluate any unacceptable risks posed to human health with respect to the proposed redevelopment. It should be noted that this assessment is protective of the chronic long-term effects of contaminants, which is also likely to be protective of any possible immediate acute effects.

A quantitative risk assessment has been undertaken initially by comparing the results of the laboratory chemical testing of non-targeted shallow soils in each area against Soil Guideline Values (SGVs), DEFRA Category 4 Screening Levels (C4SLs) or Atkins' ATRISK<sup>soil</sup> Site Specific Screening Values (SSSVs) for a residential end use with plant uptake (private gardens), the most sensitive enduses for the proposed development. Any results that may have been greater than the guideline values or where there are no comparable values, the results have subsequently been compared against Land Quality Management Sutable 4 Use Levels (Subscription No. S4UL3453) (LQM S4UL) and Category 4 Screening Levels (C4SL).

Benzo(a)pyrene has been used in the assessment as a surrogate marker for PAH contamination.

#### Topsoil

All determinands from the investigation were below their respective screening values. The laboratory testing of the Topsoil samples did not identify any asbestos.

Additional screening of the Topsoil for Pesticides was undertaken and did not identify any concentration above the laboratory detection limit or in lieu of any UK guidance the US EPA regional screening levels.

The results of the chemical testing on the Topsoil indicated that the Topsoil should be chemically suitable for re-use in private gardens, sports pitches and soft landscaped areas of the proposed development.

#### Made Ground

All determinands from the investigation were below their respective screening values. The laboratory testing of the Made Ground samples did not identify any asbestos.



### Tunbridge Wells Sand Formation

The results of the chemical testing on the natural soils (Tunbridge Wells Sand Formation) have been compared directly with the generic assessment criteria for the proposed end use. All of the results were below the relevant thresholds indicating that the environmental quality of the natural soils had not been impacted.

The laboratory testing of the Tunbridge Wells Sand Formation samples did not identify any asbestos.

### Weald Clay Formation

The results of the chemical testing on the natural soils (Weald Clay Formation) have been compared directly with the generic assessment criteria for the proposed end use. All of the results were below the relevant thresholds indicating that the environmental quality of the natural soils had not been impacted.

The laboratory testing of the Weald Clay Formation samples did not identify any asbestos.

In addition, it should be noted that although a barn with potential asbestos containing sheeting was noted within the eastern portion of the site, no asbestos was encountered within the underlying soils. It is recommended that the sheeting be removed by professionally qualified persons to prevent the risk of contaminating the near surface soils within the area of the barn.

It should be noted that the investigation within the easternmost portion of the site around the dilapidated barn was limited, this was due to the barn itself being overgrown and unsafe to work within. The immediate area surrounding the barn was cropped. The barn and field surrounds have the potential to be contaminated with asbestos cement board from the dilapidated structure. It is recommended that further investigation be carried out when the area as a whole is accessible.

## **6.3 Soil Contamination vs. Adjacent land Users**

Surrounding land uses were identified to mostly comprise residential properties. However, no contaminants of concern have been identified to date.

It is recommended that dust suppression techniques, e.g. damping down exposed soils, are employed during the demolition and construction phases on site in order to minimise the potential for airborne migration of specific hazards and to manage potential nuisance issues for adjacent land users.

## **6.4 Soil Contamination vs. Soft Landscaping**

British Standard BS3882:2015 *Specification for topsoil and requirements for use* provides assessment criteria for a number of potentially phytotoxic contaminants in terms of new planting.

The results of the chemical analysis for determinants known to pose a potential phytotoxic risk to plant growth are summarised in Table 6.4 together with the respective adopted Generic Assessment Criteria (GAC) for plant growth. The compliance criteria set out in BS3882:2015 are pH dependent and thus the GAC used relate to the pH range measured on samples recovered from the site.



| Determinant | Phytotoxicity GAC (mg/kg) |            |         | GAC Exceedances |
|-------------|---------------------------|------------|---------|-----------------|
|             | pH <6.0                   | pH 6.0-7.0 | pH >7.0 |                 |
| Zinc        | 200                       | 200        | 300     | Yes             |
| Copper      | 100                       | 135        | 200     | No              |
| Nickel      | 60                        | 75         | 110     | No              |

**Table 6.4: Summary of Plant Phytotoxicity Assessment**

The phytotoxicity assessment indicated one mild exceedance for Zinc of the assessment criteria (WS11, 0.20m bgl, 305mg/kg) out of 138No. samples. This marginally elevated Zinc concentration is likely to be diluted once Topsoil on-site is stripped and stockpiled with the rest of the Topsoil for which concentrations are below the relevant GACs based on pH level. Therefore, no additional measures are considered likely for the proposed redevelopment in relation to phytotoxicity.

## 6.5 Soil Contamination vs. Building Materials

The current guidance on selection of materials for water supply pipes to be laid in contaminated land is contained in UK Water Industry Research's (UKWIR) report reference 10/WM/03/21 (re-issued 2010). However, the guidance is not mandatory and there have been concerns raised by various industry technical associations regarding the document and the methodologies proposed. Although there are concerns regarding the document, in lieu of any further guidance in the first instance the results of this investigation have been compared with the proposed thresholds published in UKWIR Table 3.1. A mantle of Made Ground was encountered at c.10 positions across the site with in all but one case the thickness of the Made Ground being less than or equal to 0.40m. The exception recorded a Made Ground depth of 0.80m (WS91). It is therefore anticipated that any new water supply pipes will be laid directly into the natural soils. The results of the relevant chemical analyses for the Weald Clay and Upper Tunbridge Wells Formation were all below the respective thresholds and as such barrier pipe is not considered necessary.

It is recommended that the results of this investigation be presented to the water utility company as soon as reasonably practicable in order to confirm the pipe material.

As a matter of good practice, and to maximise the protection to utilities, it is recommended that clean, granular backfill is used in service runs and that marker tapes are used for all buried services.

## 6.6 Soil Contamination vs. Groundwater

No contaminants of concern have been identified within the samples tested. Therefore, no further action is deemed necessary in relation to soil contamination affecting groundwater unless any discoveries are made during any future phases of work.

## 6.7 Groundwater Contamination vs. Groundwater

Groundwater analysis has not been undertaken during this phase of investigation however, to date no contamination has been encountered within soil samples.

## 6.8 Ground Gases

Dual purpose gas and water monitoring standpipes were installed within WS04, WS05, WS40, WS39, WS03, WS20, WS76, WS92, WS36, WS43, WS01, WS16, WS24, WS78, WS12, WS37, WS28, WS34, WS06, WS45, WS53, WS48, WS08, WS60, WS72, WS87, WS68, WS69, WS09, WS52, WS65, WS71, WS90, WS70, WS13, BH103, BH102 at depths of between 1.40m and 15.00m bgl. Methane has been recorded within the range of 0.0% v/v



and 0.5% v/v, whilst carbon dioxide and oxygen have been recorded within the range of <0.1% v/v to 5.7% v/v (WS40) and 14.1% v/v to 21.6% v/v respectively. The highest gas concentrations were recorded within WS40 within the easternmost corner of the sports pitches site area. All other carbon dioxide concentrations within the other wells have been low.

A maximum VOC concentration of 2.3ppm has been recorded, whilst atmospheric pressure has been recorded within the range of 1006mb to 1020mb. Flows have been recorded within the range of <0.1l/hr and 0.2l/hr.

The monitoring recorded elevated concentrations of CO<sub>2</sub> greater than 5% v/v (up to 5.7% v/v) at the position of WS40 during the first three visits. The desk study did not identify any sources that may have impacted this location. The hazardous gas flows calculated for WS40 based on the highest CO<sub>2</sub> reading of 5.7% and the greatest flow of 0.1% is 0.0114 l/hr. Excluding the carbon dioxide results for WS40, the hazardous gas flows for methane were 0.001l/hr and for carbon dioxide 0.0078l/hr classifying the location and the site as CS/1 NHBC Green. The slightly elevated CO<sub>2</sub> is located within an area where there will be sports pitches and no structures, carbon dioxide concentrations were recorded above the 5% threshold, but these were not associated with any significant gas flows. The rewetting of a dry soil is often accompanied by a pulse in carbon dioxide concentrations due to microbial mineralisation. Any elevated concentrations of CO<sub>2</sub> are unlikely to affect any end users and as such, no further action is required regarding ground gases.

The results of the ground gas monitoring are presented in Appendix C.

## 6.9 Waste Disposal

The following information is provided for preliminary guidance purposes, as different facilities or operators may have differing acceptance criteria and Waste Acceptance Criteria (WAC) analysis may be required to confirm the exact classification. In addition, if the intention is to retain excess spoil/arising on site for specific purposes, then these soils would not comprise waste, although this is subject to confirmation and relevant declaration under the Definition of Waste Code of Practice.

Where waste soil is being disposed to landfill it must first be classified as either Hazardous or Non-Hazardous. The classification is carried out in accordance with the Environment Agency's publication WM3 'Waste Classification- Guidance on the classification and assessment of waste'. Waste that is classified as Non-Hazardous in accordance with WM3 may be disposed without further testing to a Non-Hazardous landfill. Alternatively, once the waste soils have been identified, Waste Acceptance Criteria (WAC) testing can be undertaken to establish whether the material can be disposed to an Inert landfill, a subgroup of Non-Hazardous landfill. It should be noted that inert wastes are typically from a consistent source that meet a number of qualifying criteria, and thus Made Ground commonly will not meet the requirements to be disposed as Inert.

Initially, the results of the laboratory testing were submitted for HazWaste classification, the results confirmed that the near surface soils could be disposed as non-hazardous without any further testing. Any Topsoil or Made Ground being disposed to landfill could be tested further to potentially allow the waste material to be disposed at an Inert landfill (subject to meeting the Waste Acceptance Criteria). A summary of the results of the HazWaste classification are within Appendix E.

Natural soils (Tunbridge Wells Sand Formation & Weald Clay Formation) are likely be classified as Inert Waste (under the respective EWC codes for naturally occurring soils), suitable for disposal at an inert landfill facility.

**6.10 Revised Risk Assessment**

Following on from the findings of the intrusive investigation, below is a revised risk assessment for Made Ground and shallow soils.



| Potential Source/media                                                                              | Potential Receptors          | Potential Pathways           | Likelihood | Severity | Risk and Justification                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------|------------------------------|------------------------------|------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Made Ground and Shallow Soils (Including Deposits Associated with Neighbouring Railway Line)</b> | End users                    | Direct Contact, Inhalation   | Low        | Mild     | <b>Low</b><br>Future users are likely to come into contact with soils via direct contact within gardens and soft landscaping or tracked back into the building. The chemical testing indicates that the near surface soils are of suitable chemical quality for the proposed end use. |
|                                                                                                     | Soft Landscaping             | Root Uptake                  | Low        | Mild     | <b>Low</b><br>Soft landscaping is likely to be included within the proposed development. The chemical testing indicates that the near surface soils are of suitable chemical quality for the proposed end use.                                                                        |
|                                                                                                     | Adjacent land users          | Direct Contact, Inhalation   | Unlikely   | Minor    | <b>Very Low</b><br>Adjacent site users are unlikely to come into contact with and affected soils on site. Additionally, natural soils are not anticipated to represent a risk of harm to human health based on the findings of the testing.                                           |
|                                                                                                     | Water supply pipes           | Chemical Attack              | Low        | Mild     | <b>Low</b><br>Water supply pipes are likely to be placed in natural soils based on the depths of Made Ground recorded during the investigation. Based on the chemical test result on the natural soils barrier pipe would not be required.                                            |
|                                                                                                     | Buildings and infrastructure | Chemical Attack              | Low        | Minor    | <b>Very Low</b><br>Foundations and utilities will be placed within natural soils.                                                                                                                                                                                                     |
|                                                                                                     | Groundwater                  | Vertical & Lateral Migration | Likely     | Minor    | <b>Low</b><br>The Superficial deposits and Upper Tunbridge Wells Sand Formation beneath the site are classified as Secondary A aquifers. However, the Weald Clay Formation which is                                                                                                   |



| Potential Source/media                                                                                      | Potential Receptors            | Potential Pathways | Likelihood | Severity | Risk and Justification                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------|--------------------------------|--------------------|------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                             |                                |                    |            |          | beneath the majority of the site is classified as unproductive strata.                                                                                                                                                                                                                                 |
| <b>Naturally Occurring Chemical Ground Conditions That Could Affect End Users or Construction Materials</b> | End users                      | Direct Contact     | Unlikely   | Minor    | <b>Very Low</b><br>Future users are unlikely to come into contact with natural soils beneath the site. No naturally occurring chemical conditions are likely to present harm to end users                                                                                                              |
|                                                                                                             | Water supply pipes             | Chemical Attack    | Unlikely   | Minor    | <b>Low</b><br>Water supply pipes are likely to be placed in natural soils based on the depths of Made Ground recorded during the investigation. Based on the chemical test result on the natural soils barrier pipe would not be required.                                                             |
|                                                                                                             | Buildings and infra- structure | Chemical Attack    | Low        | Minor    | <b>Very Low</b><br>The near surface soils of the Weald Clay Formation and Tunbridge Wells Sand Formation were classified as DS-1, AC-1s.                                                                                                                                                               |
| <b>Ground Gases/Vapours</b>                                                                                 | End Users                      | Inhalation         | Low        | Minor    | <b>Very Low</b><br>Significant volumes of putrescible material or high concentrations of VOCs from hydrocarbon contamination would be necessary in any Made Ground for significant ground gas production. No significant Made Ground or putrescible material was encountered during the investigation. |
|                                                                                                             | Adjacent land users            | Inhalation         | Unlikely   | Minor    | <b>Very Low</b><br>Adjacent site users are unlikely to be adversely affected by ground gases originating on the site.                                                                                                                                                                                  |
|                                                                                                             | Soft Landscaping               | Root Uptake        | Unlikely   | Minor    | <b>Very Low</b>                                                                                                                                                                                                                                                                                        |



| Potential Source/media | Potential Receptors          | Potential Pathways                                          | Likelihood | Severity | Risk and Justification                                                                                                                                                                                                                                                                                 |
|------------------------|------------------------------|-------------------------------------------------------------|------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        |                              |                                                             |            |          | Soft landscaping is not expected to be adversely affected by any ground gases.                                                                                                                                                                                                                         |
|                        | Buildings and infrastructure | Gas Accumulation and Potential Explosion of Flammable Gases | Unlikely   | Minor    | <b>Very Low</b><br>Significant volumes of putrescible material or high concentrations of VOCs from hydrocarbon contamination would be necessary in any Made Ground for significant ground gas production. No significant Made Ground or putrescible material was encountered during the investigation. |

Table 6.4: Revised Risk Assessment



## 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.

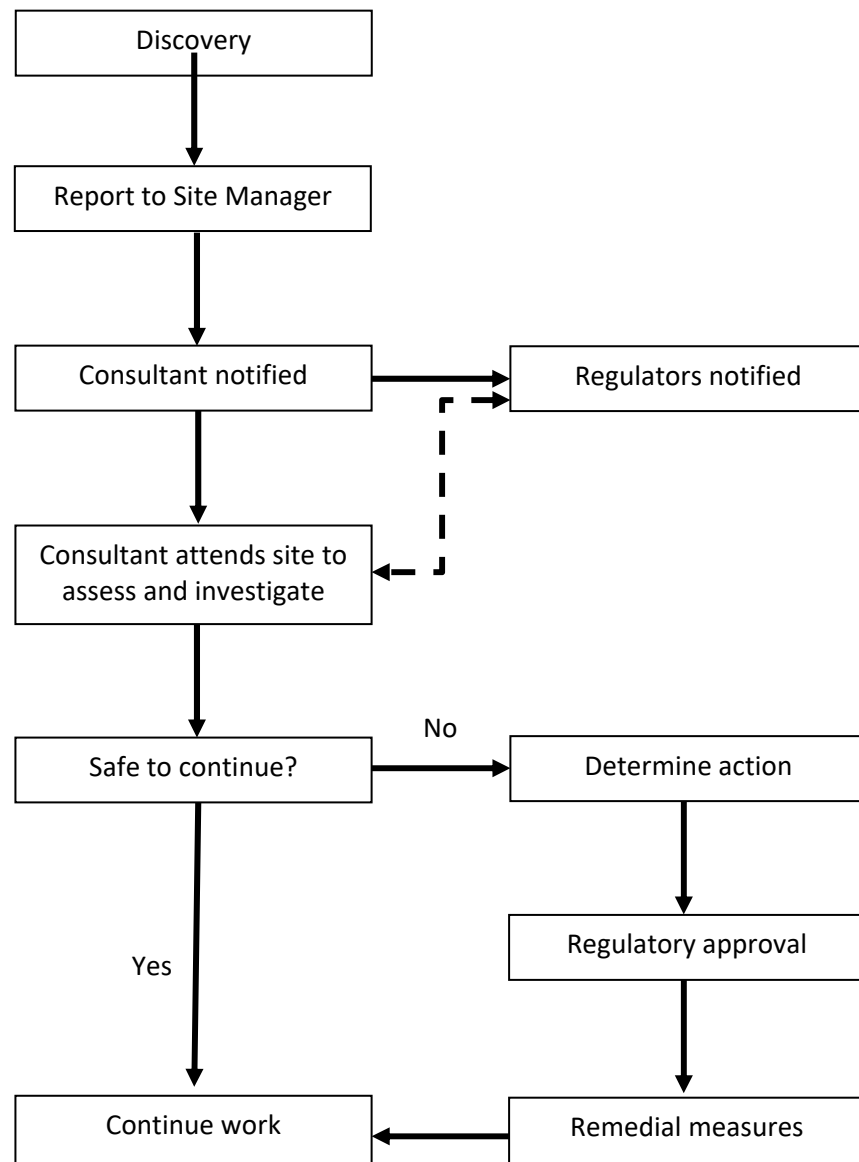
A copy of the discovery strategy must be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious, abnormal, unforeseen or contaminated ground and/or groundwater conditions they may encounter.

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 shown overleaf.



**Caveat**

*The data collected from the investigations have been used to provide an interpretation of the geo-environmental conditions pertaining to the site. The recommendations and opinions expressed in this report are based on the data obtained.*

*Geo-Environmental Service Limited takes no responsibility for conditions that either have not been revealed in the available records, or that occurs between or under points of physical investigation. Whilst every effort has been made to interpret the conditions, such information is only indicative and liability cannot be accepted for its accuracy.*

*Information contained in this report is intended for the use of the client and their agents, and Geo-Environmental Services Limited can take no responsibility for the use of this information by any third party for uses other than that described in this report.*

*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. Such reservations have been indicated in the text where such conditions are considered to apply.*

*Geo-Environmental Services Limited does not indemnify any third parties such as the vendor against any dispute or claim arising from any finding or result of this investigation or any claim or dispute arising as a result of any decisions made thereof.*

**Figure 1**  
**Site Location Plan**

Project Title: North Horsham II  
Location : Horsham  
Project No. : GE20724  
Client : Legal & General

Title : Figure 1 - Site Location Plan  
Scale: 1:25000  
Engineer: GE



Legend Key  
Project Bounds - Project Bounds

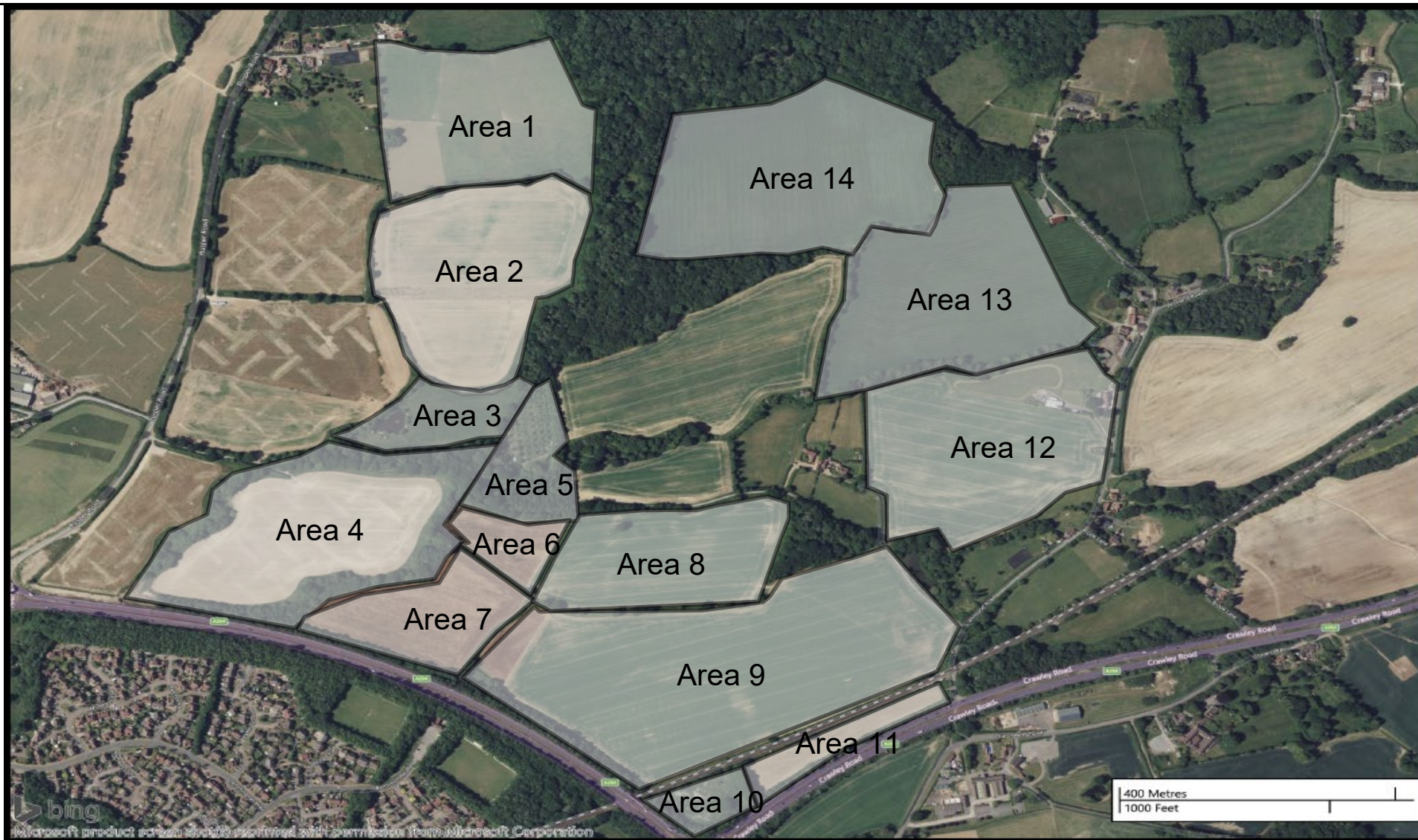


Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation

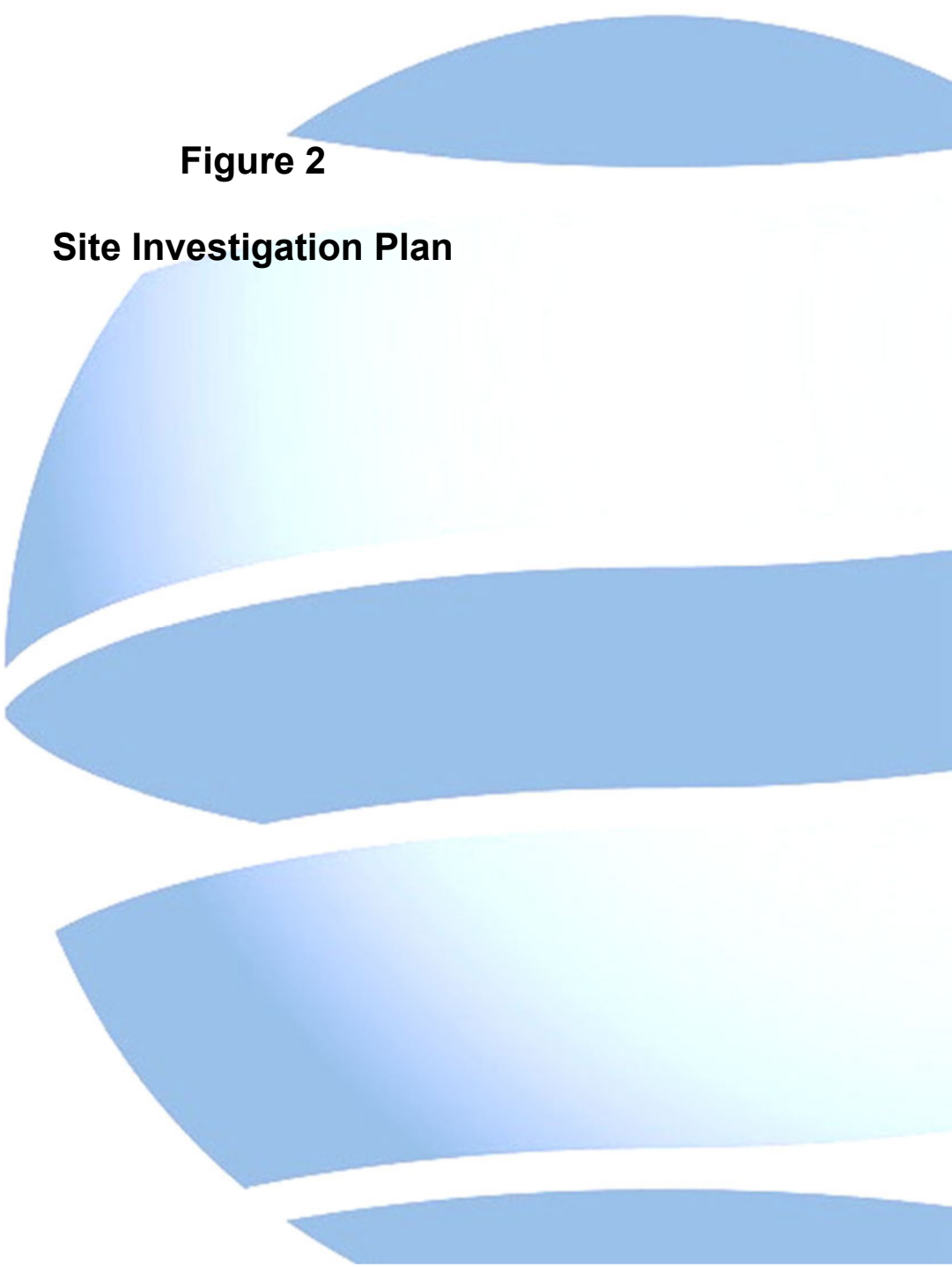
1 Kilometres  
4000 Feet



**Figure 1a**  
**Site Description Plan**



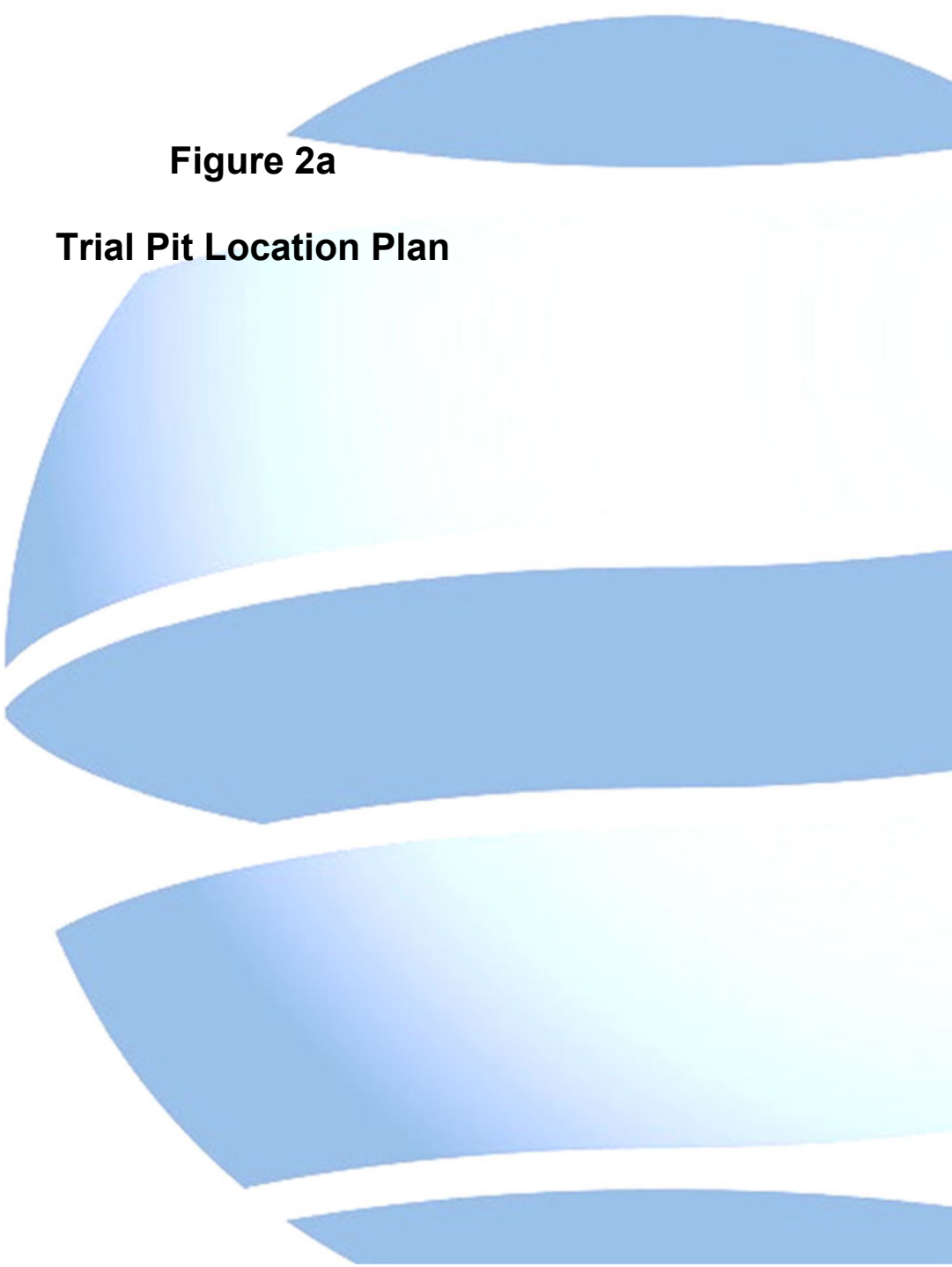
|                 |                        |                  |            |                                                                                                                                                                    |                                                                                                                   |  |
|-----------------|------------------------|------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--|
| <b>Project:</b> | North Horsham Phase II |                  |            | <b>Title</b>                                                                                                                                                       | Site Description Plan                                                                                             |  |
| <b>Client:</b>  | Legal & General        |                  |            | <b>Geo-Environmental Services Ltd</b><br><br>Unit 7 Danworth Farm, Cuckfield Road<br><br>Hurstpierpoint, West Sussex BN6 9GL<br><br>+44(0)1273 832972 www.gesl.net | <br><b>Geo-Environmental</b> |  |
| <b>Ref No:</b>  | GE20724                | <b>Revision:</b> | 1          |                                                                                                                                                                    |                                                                                                                   |  |
| <b>Drawn:</b>   | TG                     | <b>Date:</b>     | 15.11.2022 |                                                                                                                                                                    |                                                                                                                   |  |
| <b>Figure:</b>  | Figure 1a              | <b>Scale:</b>    | NTS        |                                                                                                                                                                    |                                                                                                                   |  |



**Figure 2**

**Site Investigation Plan**





**Figure 2a**

**Trial Pit Location Plan**

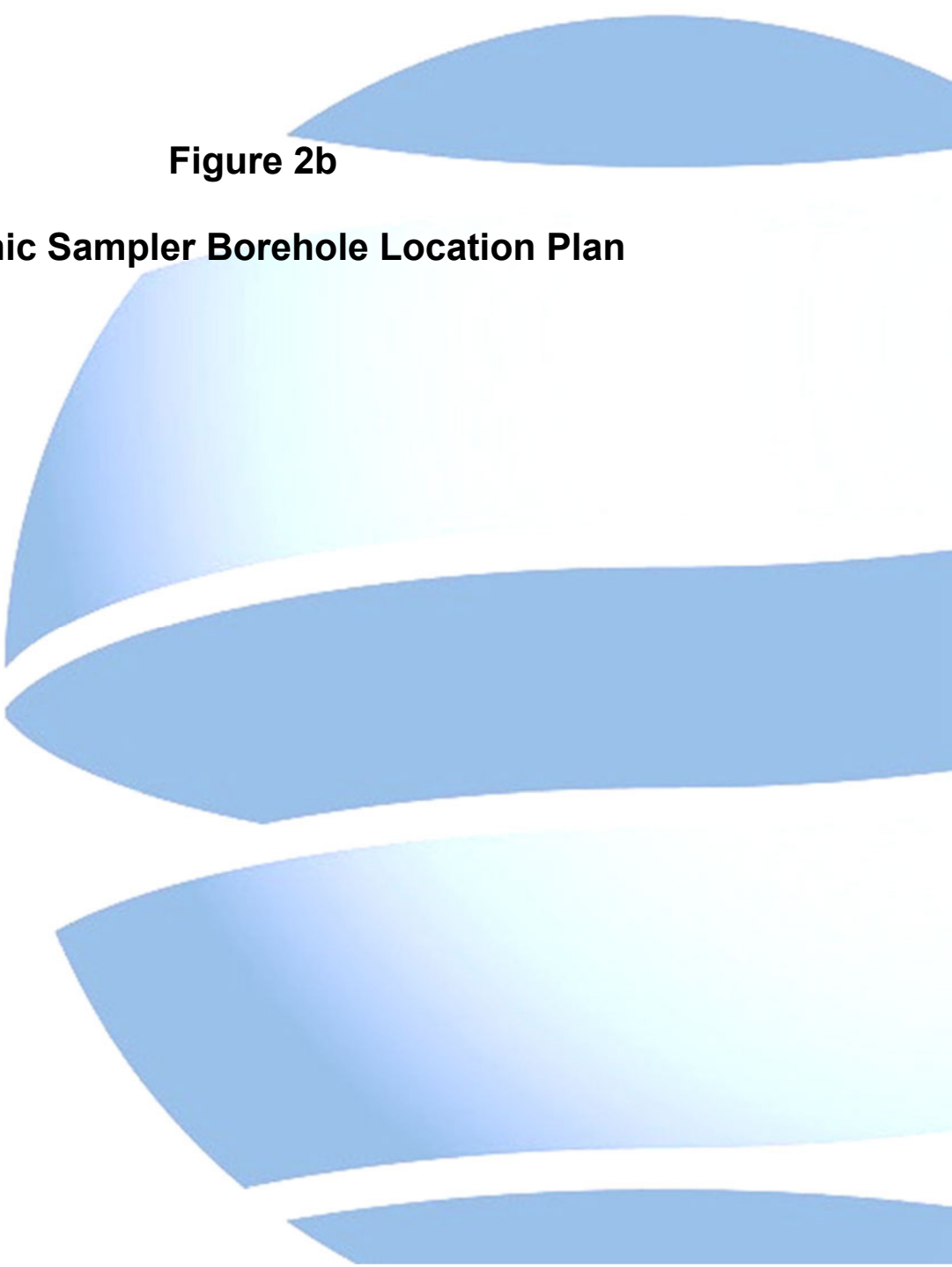
Project Id: GE20724  
Project Title: North Horsham II  
Location: Horsham  
Client: Legal & General

Title: Trial Pit Locations  
Scale: 1:2500@A1  
Engineer: GE  
Figure: Figure 2a



Legend Key  
Trial Pit Locations - TP





**Figure 2b**

**Dynamic Sampler Borehole Location Plan**

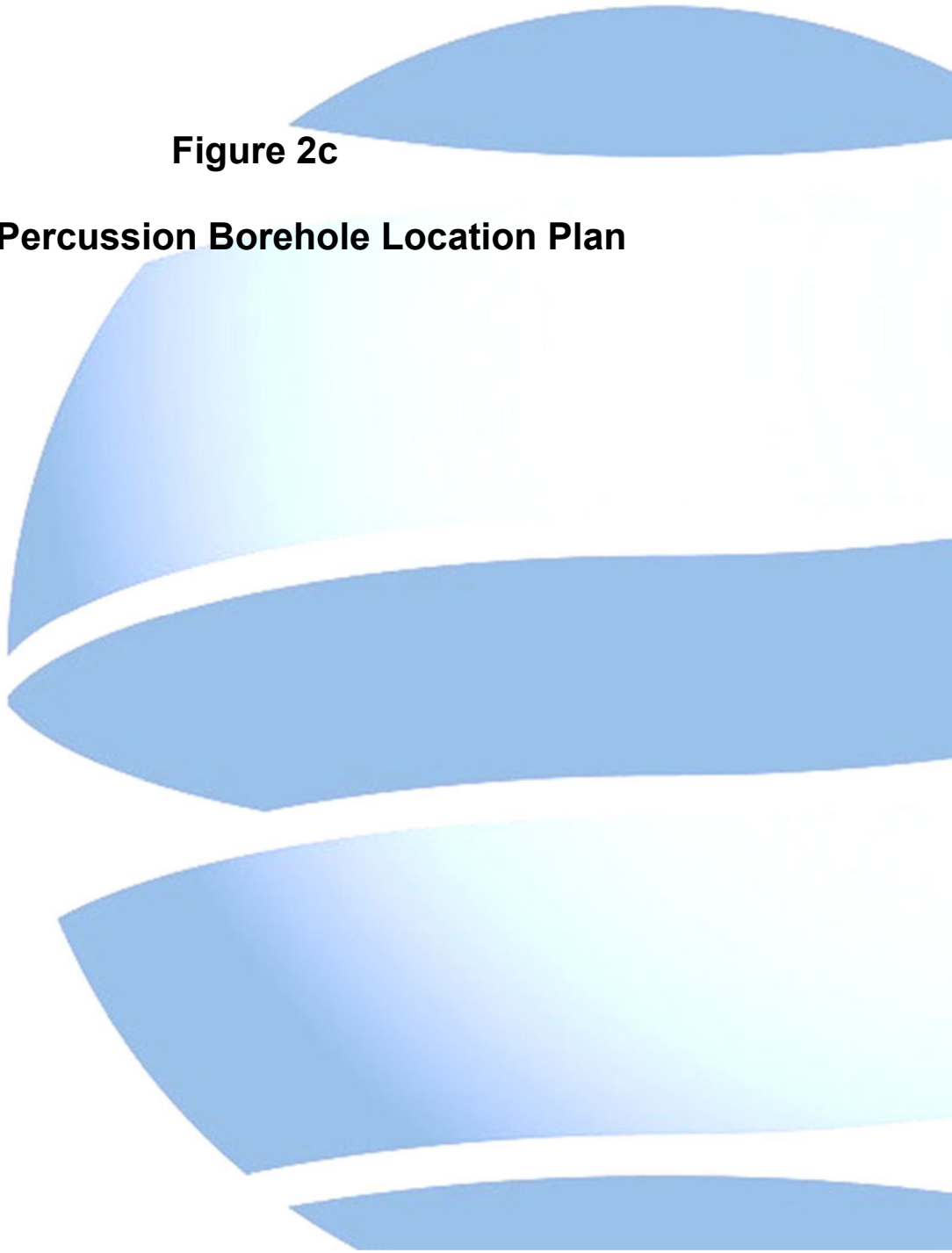
Project Id: GE20724  
Project Title: North Horsham II  
Location: Horsham  
Client: Legal & General

Title: Dynamic Sampler Borehole Locations  
Scale: 1:2500@A1  
Engineer: GE  
Figure: Figure 2b



Legend Key  
● Dynamic Sampler Borehole Locations - WS





**Figure 2c**

**Cable Percussion Borehole Location Plan**

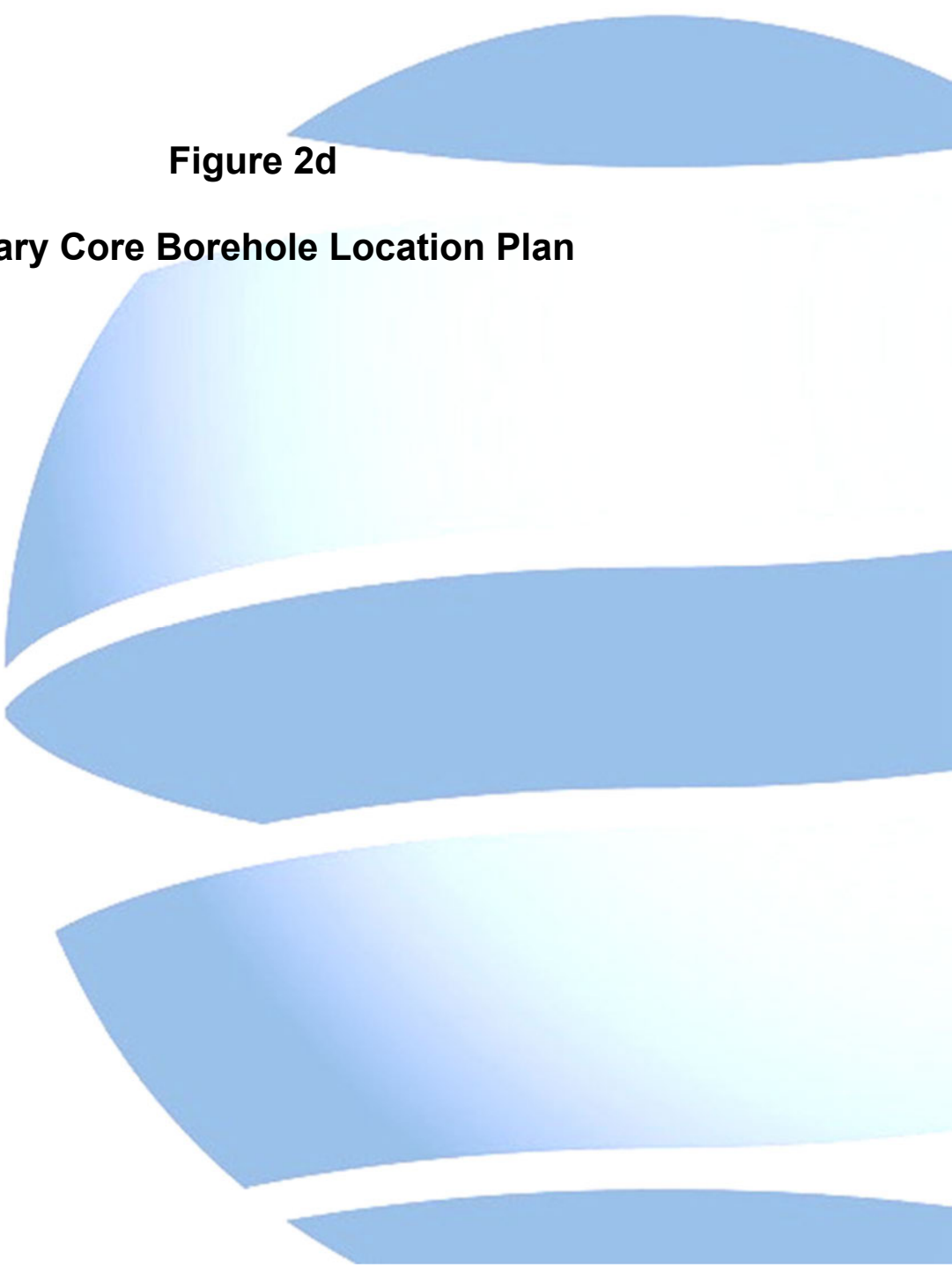
Project Id: GE20724  
Project Title: North Horsham II  
Location: Horsham  
Client: Legal & General

Title: Cable Percussion Borehole Locations  
Scale: 1:2500@A1  
Engineer: GE  
Figure: Figure 2c

Legend Key

 Cable Percussion Borehole Locations - CP





**Figure 2d**

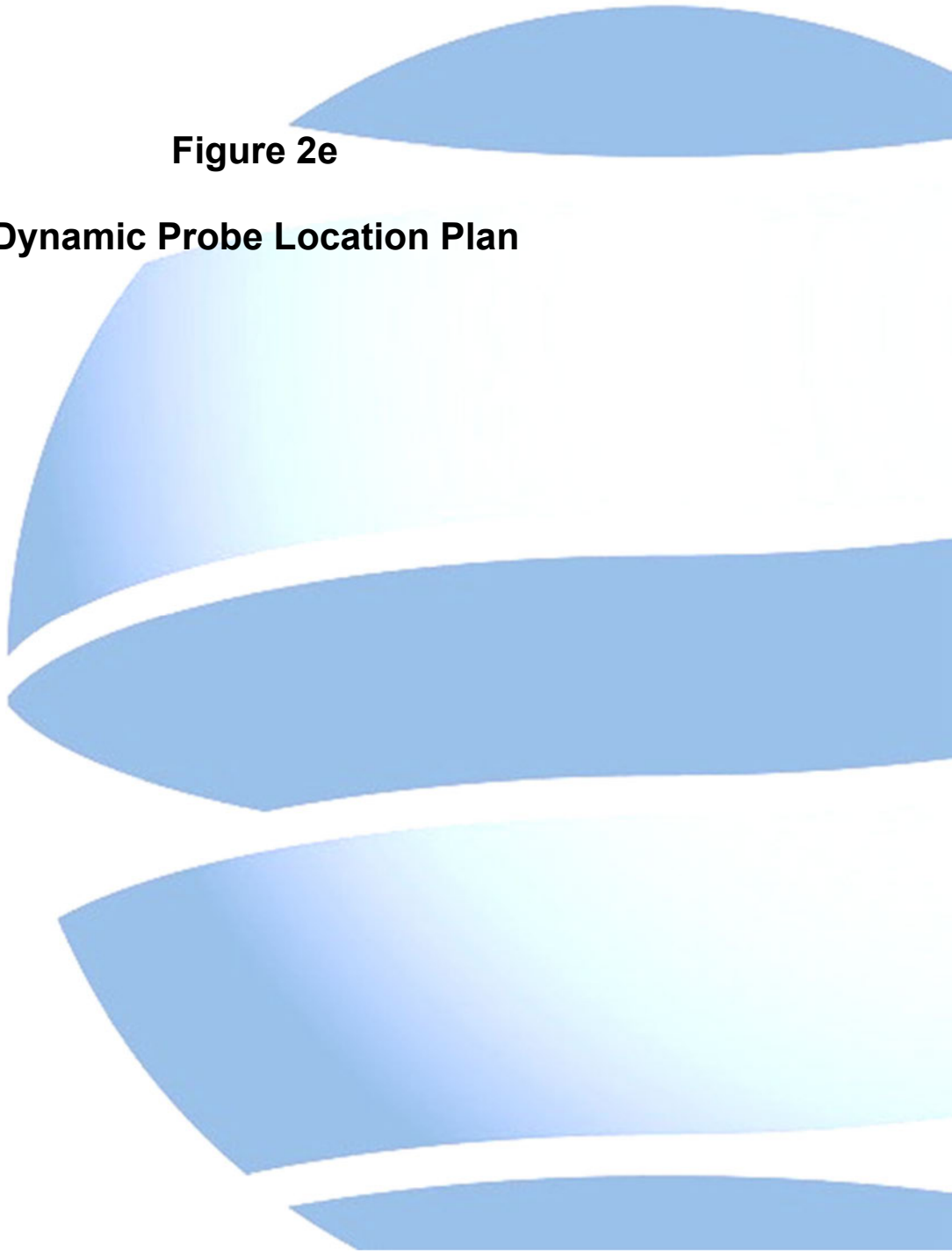
**Rotary Core Borehole Location Plan**

Project Id: GE20724  
Project Title: North Horsham II  
Location: Horsham  
Client: Legal & General

Title: Rotary Core Borehole Locations  
Scale: 1:2500@A1  
Engineer: GE  
Figure: Figure 2d

Legend Key  
◆ Rotary Core Borehole Locations - RC





**Figure 2e**  
**Dynamic Probe Location Plan**

Project Id: GE20724  
Project Title: North Horsham II  
Location: Horsham  
Client: Legal & General

Title: Dynamic Probe Locations  
Scale: 1:2500@A1  
Engineer: GE  
Figure: Figure 2e

Legend Key  
▲ Dynamic Probe Locations



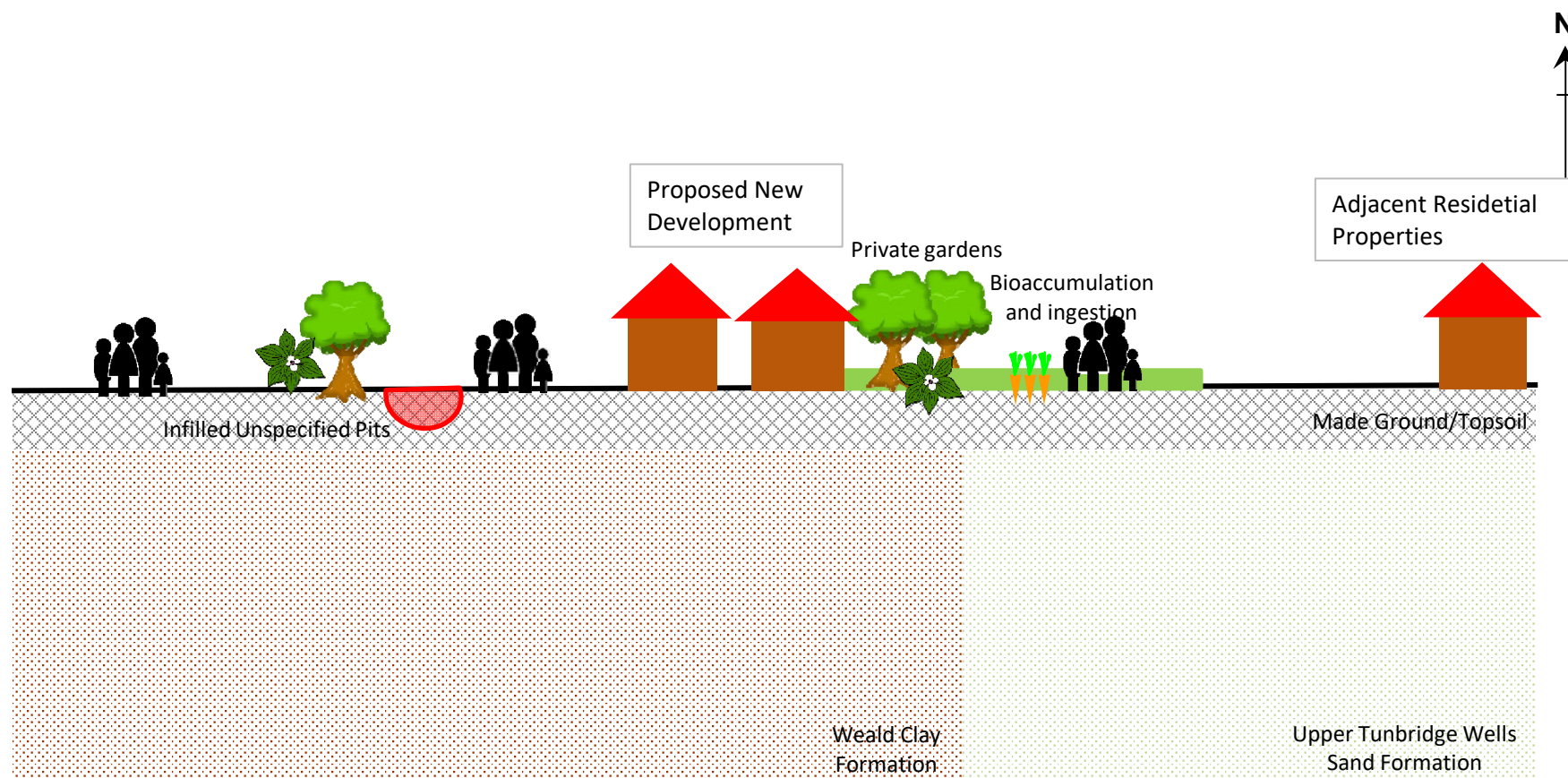
**Figure 2f**  
**CBR Test Location Plan**

Legend Key  
◆ CBR Locations - CBR

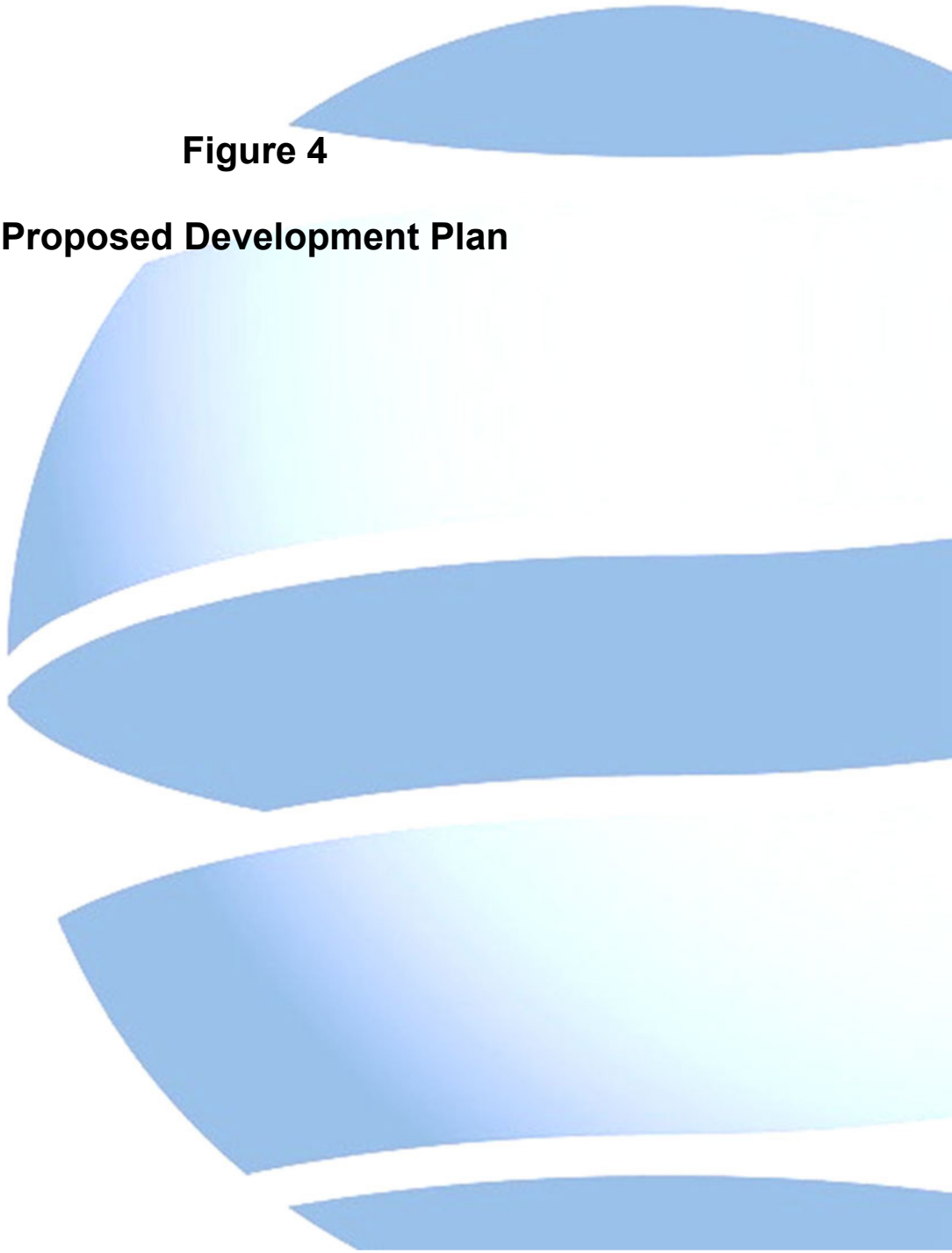


**Figure 3**

**Graphical Conceptual Site Model (Future Use)**

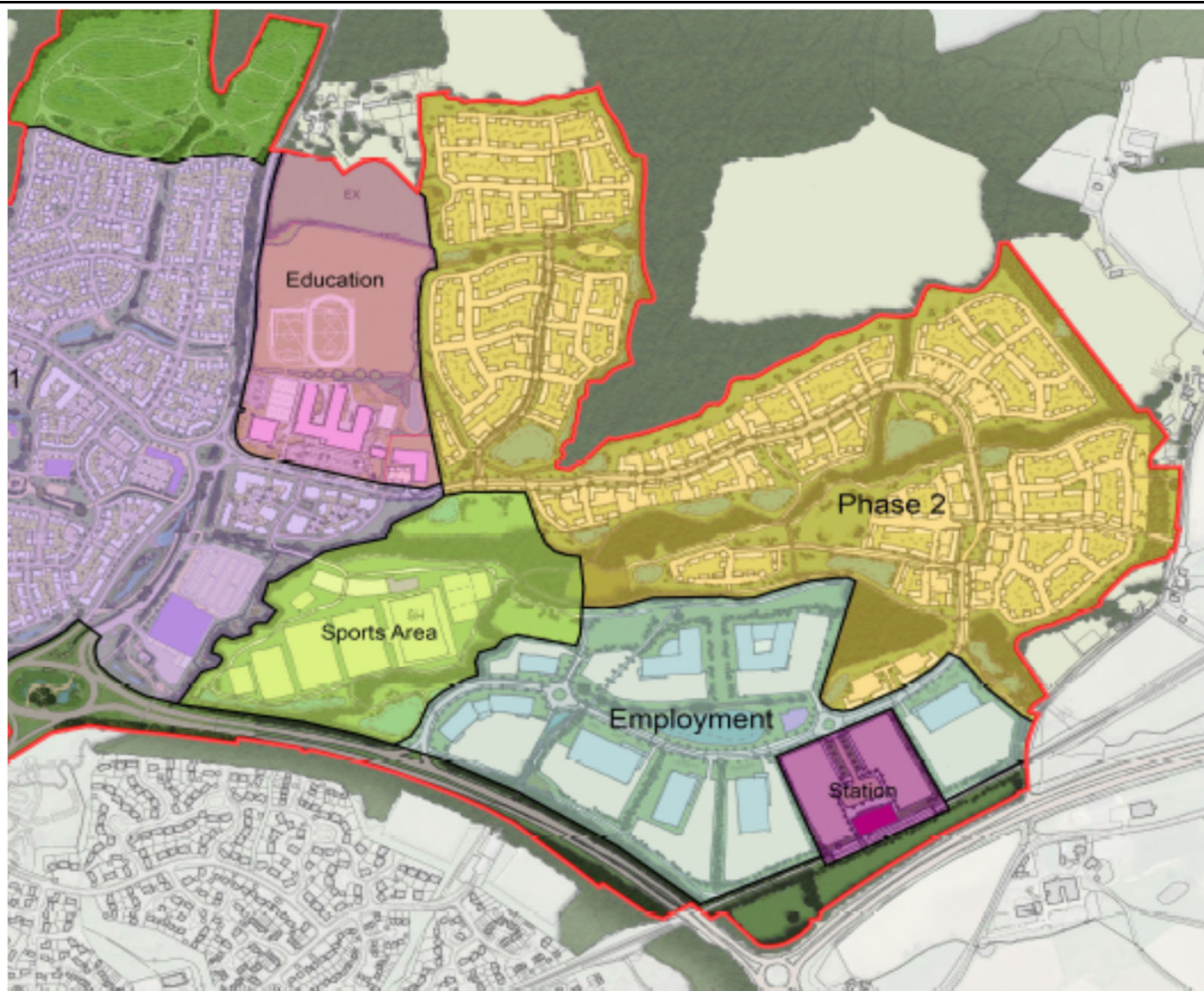


|                 |                                      |                  |              |                                                                                                                                                                                                                           |                                                                                                                   |  |  |
|-----------------|--------------------------------------|------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--|--|
| <b>Project:</b> | North Horsham Phase II               |                  |              | <b>Title</b>                                                                                                                                                                                                              | Conceptual Site Model                                                                                             |  |  |
| <b>Client:</b>  | L&G Strategic Land North Horsham Ltd |                  |              | <b>Geo-Environmental Services Ltd</b><br><br><b>Unit 7 Danworth Farm, Cuckfield Road</b><br><br><b>Hurstpierpoint, West Sussex BN6 9GL</b><br><br><b>+44(0)1273 832972 <a href="http://www.gesl.net">www.gesl.net</a></b> | <br><b>Geo-Environmental</b> |  |  |
| <b>Ref No:</b>  | GE20724                              | <b>Revision:</b> | 1.0          |                                                                                                                                                                                                                           |                                                                                                                   |  |  |
| <b>Drawn:</b>   | TG                                   | <b>Date:</b>     | 21/09/2022   |                                                                                                                                                                                                                           |                                                                                                                   |  |  |
| <b>Figure:</b>  | 3                                    | <b>Scale:</b>    | Not To Scale |                                                                                                                                                                                                                           |                                                                                                                   |  |  |

A decorative graphic element consisting of several overlapping, wavy, blue shapes that resemble stylized water or clouds, positioned on the right side of the page.

**Figure 4**

**Proposed Development Plan**



|                 |                                                  |                  |            |                                                                                                                                                                                                      |                                                                                                                       |  |
|-----------------|--------------------------------------------------|------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|--|
| <b>Project:</b> | North Horsham (Phase 2)                          |                  |            | <b>Title</b>                                                                                                                                                                                         | Proposed Development Plan                                                                                             |  |
| <b>Client:</b>  | Legal & General Strategic Land North Horsham Ltd |                  |            | <b>Geo-Environmental Services Ltd</b><br><br>Unit 7 Danworth Farm, Cuckfield Road<br><br>Hurstpierpoint, West Sussex BN6 9GL<br><br>+44(0)1273 832972 <a href="http://www.gesl.net">www.gesl.net</a> | <br><br><b>Geo-Environmental</b> |  |
| <b>Ref No:</b>  | GE20724                                          | <b>Revision:</b> | v1         |                                                                                                                                                                                                      |                                                                                                                       |  |
| <b>Drawn:</b>   | AP                                               | <b>Date:</b>     | 25/05/2022 |                                                                                                                                                                                                      |                                                                                                                       |  |
| <b>Figure:</b>  | 4                                                | <b>Scale:</b>    | nts        |                                                                                                                                                                                                      |                                                                                                                       |  |

**Figure 5**

**Plan Showing Positions Where Made Ground was  
Recorded**

Project Id: GE20724  
Project Title: North Horsham II  
Location: Horsham  
Client: Legal & General

Title: Plan Showing Positions where Made Ground was Recorded  
Scale: 1:2500 @ A1  
Engineer: GE  
Figure: Figure 5



**Legend Key**

- Yellow square: Trial Pit Locations - TP
- Red circle: Dynamic Sampler Borehole Locations - WS
- Red circle: Location of Made Ground



**Figure 6**

**Locations of Artesian Water Strikes**

Project Id: GE20724  
Project Title: North Horsham II  
Location: Horsham  
Client: Legal & General

Title: Locations of Artesian Water Strikes  
Scale: 1:2500 @ A1  
Engineer: GE  
Figure: Figure 6

**Legend Key**  
◆ Rotary Core Borehole Locations - RC  
● Artesian Water Strikes



**Figure 7**  
**Chemical Test Locations**

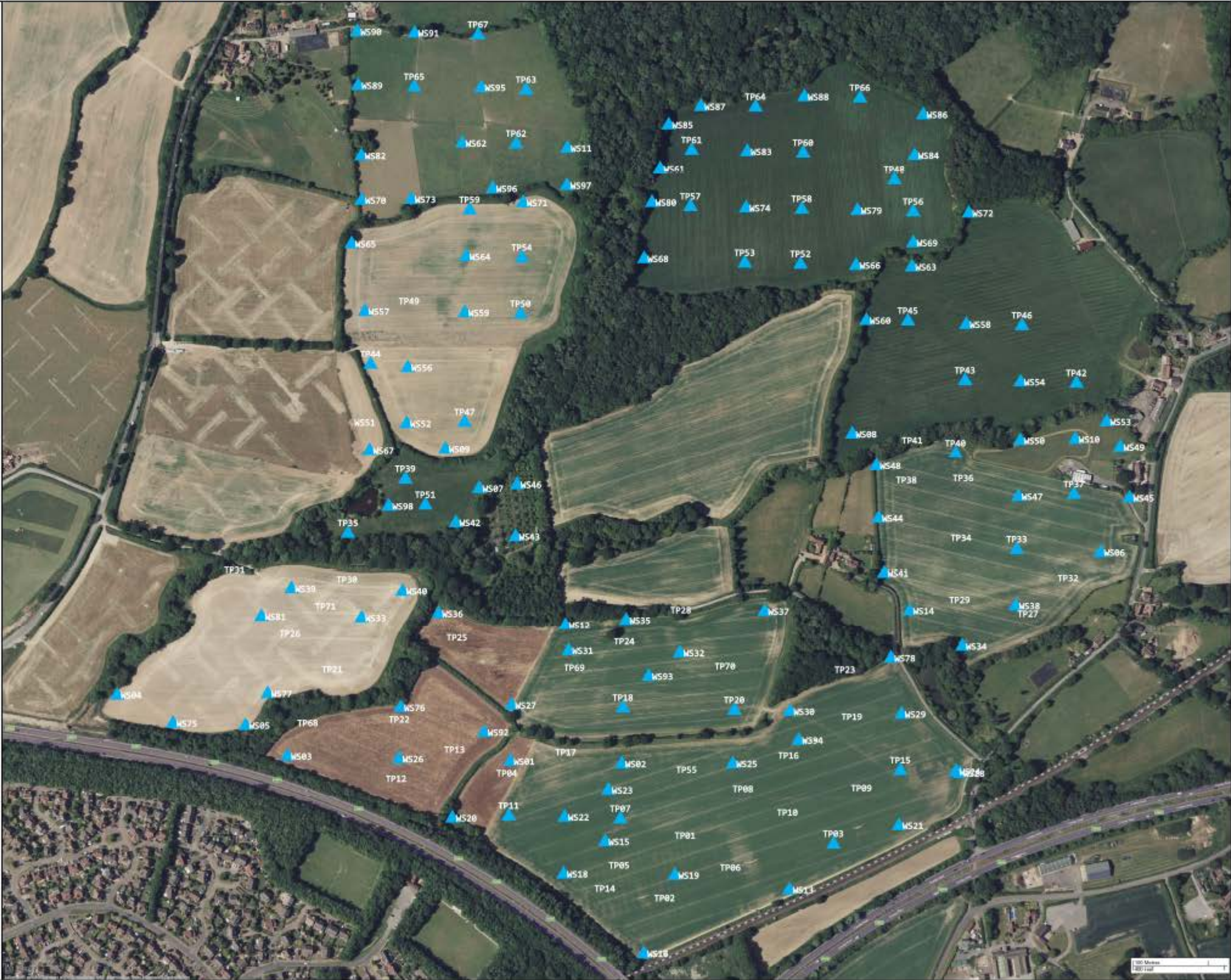
Project Id: GE20724  
Project Title: North Horsham II  
Location: Horsham  
Client: Legal & General

Title: Chemical Test Locations  
Scale: 1:2500 @ A1  
Engineer: GE  
Figure: 7



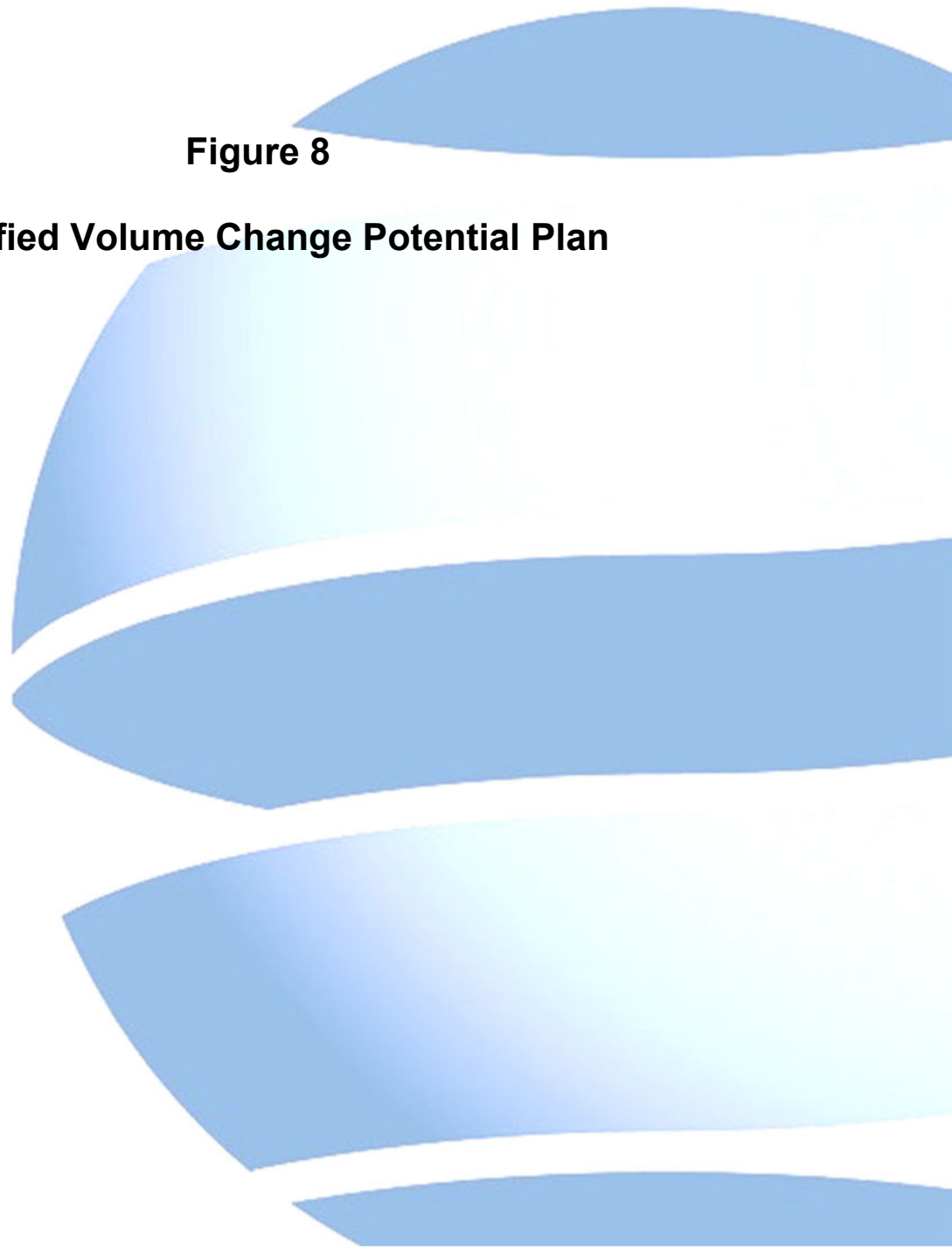
**Legend Key**

▲ Location of Contamination Tests



**Figure 8**

**Modified Volume Change Potential Plan**



Project Id: GE20724  
Project Title: North Horsham II  
Location: Horsham  
Client: Legal & General

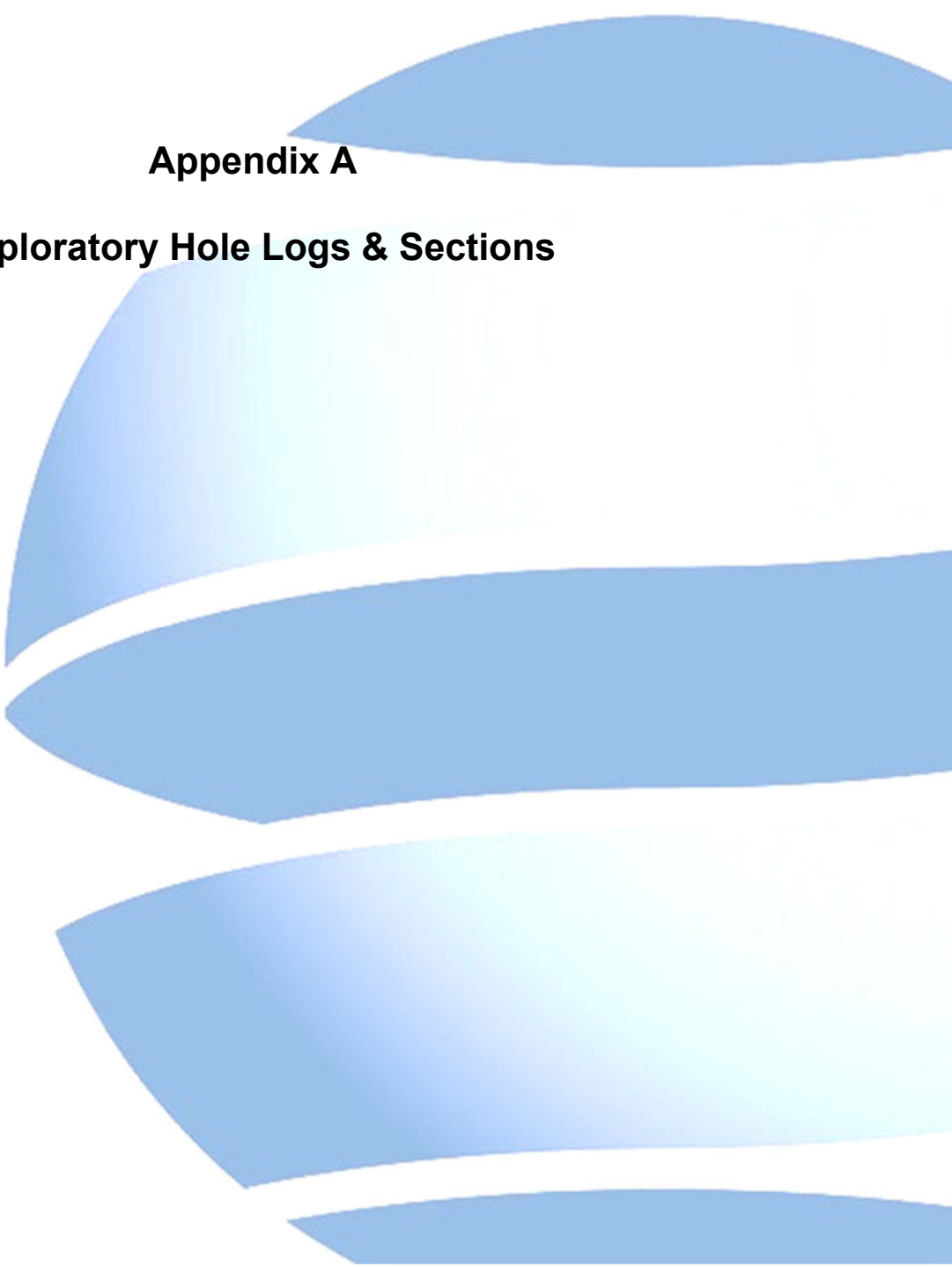
Title: Modified Volume Change Potential Plan  
Scale: 1:2500@A1  
Engineer: GE  
Figure: 8



**Legend Key**

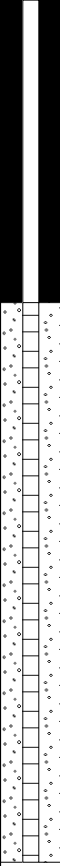
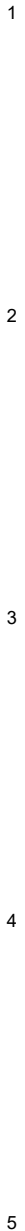
- Modified Medium VCP gr half m less than 3m
- Modified Low VCP gr half m less than 3m -
- Modified High VCP gr half m less than 3m
- Modified Low VCP Potential Zone





## **Appendix A**

### **Exploratory Hole Logs & Sections**

|  <div> Unit 7, Danworth Farm<br/> Hurstpierpoint<br/> BN6 9GL<br/> <a href="http://www.gesl.net">www.gesl.net</a> </div> |               |                             |              | <div>Borehole Log</div> |           |                            |                                                                                                                                                                                                                                                                                                | Borehole No.<br><b>WS01</b><br>Sheet 1 of 1                                          |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------|--------------|-------------------------|-----------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--|
| Project Name: North Horsham II                                                                                                                                                                           |               |                             |              | Project No.<br>GE20724  |           | Co-ords: 519625E - 133375N |                                                                                                                                                                                                                                                                                                | Hole Type<br>WLS                                                                     |  |
| Location: Horsham                                                                                                                                                                                        |               |                             |              | Level: 56.20            |           | Scale<br>1:25              |                                                                                                                                                                                                                                                                                                |                                                                                      |  |
| Client: Legal & General                                                                                                                                                                                  |               |                             |              | Dates: 06/05/2022       |           | Logged By<br>KO            |                                                                                                                                                                                                                                                                                                |                                                                                      |  |
| Well                                                                                                                                                                                                     | Water Strikes | Sample and In Situ Testing  |              |                         | Depth (m) | Level (m)                  | Legend                                                                                                                                                                                                                                                                                         | Stratum Description                                                                  |  |
|                                                                                                                                                                                                          |               | Depth (m)                   | Type         | Results                 |           |                            |                                                                                                                                                                                                                                                                                                |                                                                                      |  |
|                                                                                                                        |               | 0.10                        | ES           |                         | 0.20      | 56.00                      |  Grass overlying brown silty clay with abundant rootlets.<br><b>TOPSOIL</b>                                                                                                                                   |  |  |
|                                                                                                                                                                                                          |               | 0.50                        | D            |                         |           |                            |  Orangish brown and pale grey silty slightly gravelly CLAY with black ferruginous fragments and orange staining. Gravel is fine to coarse sub angular siltstone.<br><b>WEALD CLAY</b><br><i>Some rootlets</i> |                                                                                      |  |
|                                                                                                                                                                                                          |               | 0.70                        | ES           |                         |           |                            |                                                                                                                                                                                                                                                                                                |                                                                                      |  |
|                                                                                                                                                                                                          |               | 1.00                        | D            |                         |           |                            |                                                                                                                                                                                                                                                                                                |                                                                                      |  |
|                                                                                                                                                                                                          |               | 1.20                        | ES           |                         | 2.10      | 54.10                      |  Orangish brown and pale grey slightly clayey, weakly cemented SILT with occasional thin siltstone bands and rare iron staining.<br><b>WEALD CLAY</b>                                                       |                                                                                      |  |
|                                                                                                                                                                                                          |               | 1.50                        | D            |                         |           |                            |                                                                                                                                                                                                                                                                                                |                                                                                      |  |
|                                                                                                                                                                                                          |               | 2.00                        | D            |                         |           |                            |                                                                                                                                                                                                                                                                                                |                                                                                      |  |
|                                                                                                                                                                                                          |               | 2.50                        | D            |                         | 2.60      | 53.60                      |  Pale grey weakly cemented SILT with rare iron staining.<br><b>WEALD CLAY</b>                                                                                                                               |                                                                                      |  |
|                                                                                                                                                                                                          | 2.85          | D                           |              | 2.85                    | 53.35     | End of Borehole at 2.85m   |                                                                                                                                                                                                                                                                                                |                                                                                      |  |
| Dynamic Sampling Run Details                                                                                                                                                                             |               | Water Strike Details (mbgl) |              | Remarks                 |           |                            |                                                                                                                                                                                                                                                                                                |                                                                                      |  |
| Depth Top                                                                                                                                                                                                | Depth Base    | Diameter                    | Depth Strike | Rose To                 | Dry       |                            |                                                                                                                                                                                                                                                                                                |                                                                                      |  |
|                                                                                                                                                                                                          |               |                             |              |                         |           |                            |                                                                                                                                                                                                                                                                                                |                                                                                      |  |



|                  |         |
|------------------|---------|
| Borehole: Photos | WS01    |
|                  | GE20724 |
|                  |         |



Geo-Environmental www.gesl.net

Unit 7, Danworth Farm  
Hurstpierpoint  
BN6 9GL

# Borehole Log

Borehole No.

**WS02**

Sheet 1 of 1

Project Name: North Horsham II

Project No.  
GE20724

Co-ords: 519775E - 133375N

Hole Type  
WLS

Location: Horsham

Level: 57.80

Scale  
1:25

Client: Legal & General

Dates: 11/05/2022

Logged By  
KO

| Well | Water Strikes | Sample and In Situ Testing |      |           | Depth (m) | Level (m) | Legend | Stratum Description                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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|      |               | Depth (m)                  | Type | Results   |           |           |        |                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|      |               | 0.20                       | ES   | 2.9kg/cm2 | 0.30      | 57.50     |        | Brown silty clay with abundant rootlets and roots 1-2mm and some black decomposed rootlets. TOPSOIL | 1 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Image 1. 1652272581841.jpg:  
WindowSamplerPhoto



Geo-Environmental

Unit 7, Danworth Farm  
Hurstpierpoint  
BN6 9GL  
www.gesl.net

# Borehole Log

Borehole No.

**WS03**

Sheet 1 of 1

Project Name: North Horsham II

Project No.  
GE20724

Co-ords: 519325E - 133375N

Hole Type  
WLS

Location: Horsham

Level: 54.22

Scale  
1:25

Client: Legal &amp; General

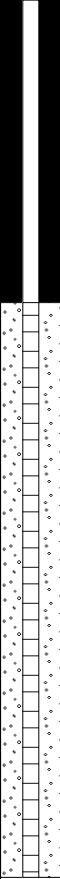
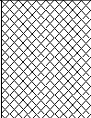
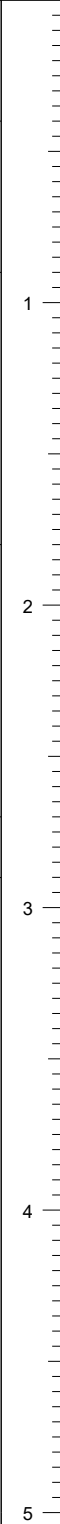
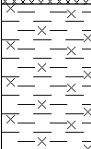
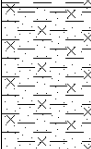
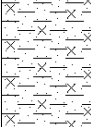
Dates: 06/05/2022

Logged By  
KO

| Well | Water Strikes | Sample and In Situ Testing |      |         | Depth (m) | Level (m) | Legend | Stratum Description                                                                                                               |   |  |  |  |
|------|---------------|----------------------------|------|---------|-----------|-----------|--------|-----------------------------------------------------------------------------------------------------------------------------------|---|--|--|--|
|      |               | Depth (m)                  | Type | Results |           |           |        |                                                                                                                                   |   |  |  |  |
|      |               | 0.10                       | ES   |         | 0.30      | 53.92     |        | Grass overlying dark brown silty gravelly clay with abundant rootlets. Gravel is fine to coarse sub angular siltstone.<br>TOPSOIL | 1 |  |  |  |
|      |               | 0.40                       | ES   |         |           |           |        | Very stiff orangish brown and pale grey mottled silty CLAY with some sandstone fragments and orange staining.<br>WEALD CLAY       |   |  |  |  |
|      |               | 0.50                       | D    |         |           |           |        |                                                                                                                                   |   |  |  |  |
|      |               | 1.00                       | D    |         | 1.70      | 52.52     |        | Pale grey and brown slightly clayey, weakly cemented SILT with occasional thin siltstone bands and orange staining.<br>WEALD CLAY | 2 |  |  |  |
|      |               | 1.50                       | D    |         |           |           |        |                                                                                                                                   |   |  |  |  |
|      |               | 1.60                       | ES   |         |           |           |        |                                                                                                                                   |   |  |  |  |
|      |               | 2.00                       | D    |         | 2.50      | 51.72     |        | End of Borehole at 2.50m                                                                                                          | 3 |  |  |  |
|      |               | 2.50                       | D    |         |           |           |        |                                                                                                                                   |   |  |  |  |
|      |               |                            |      |         |           |           |        |                                                                                                                                   |   |  |  |  |
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**Image 1.** 1651846658270.jpg:  
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|  <div> Unit 7, Danworth Farm<br/> Hurstpierpoint<br/> BN6 9GL<br/> <a href="http://www.gesl.net">www.gesl.net</a> </div> |                      |                             |              | <h1>Borehole Log</h1>                                                             |                                                                                                                                                                                    |                                                                                      |                                                                                   | Borehole No.<br><b>WS04</b><br>Sheet 1 of 1                                                                                                 |                                                                                      |                                                                                                                             |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------|--------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--|
| Project Name: North Horsham II                                                                                                                                                                           |                      |                             |              | Project No.<br>GE20724                                                            |                                                                                                                                                                                    | Co-ords: 519094E - 133451N                                                           |                                                                                   | Hole Type<br>WLS                                                                                                                            |                                                                                      |                                                                                                                             |  |
| Location: Horsham                                                                                                                                                                                        |                      |                             |              | Level: 51.80                                                                      |                                                                                                                                                                                    | Scale<br>1:25                                                                        |                                                                                   |                                                                                                                                             |                                                                                      |                                                                                                                             |  |
| Client: Legal & General                                                                                                                                                                                  |                      |                             |              | Dates: 04/05/2022                                                                 |                                                                                                                                                                                    | Logged By<br>KO                                                                      |                                                                                   |                                                                                                                                             |                                                                                      |                                                                                                                             |  |
| Well                                                                                                                                                                                                     | Water Strikes        | Sample and In Situ Testing  |              |                                                                                   | Depth (m)                                                                                                                                                                          | Level (m)                                                                            | Legend                                                                            | Stratum Description                                                                                                                         |                                                                                      |                                                                                                                             |  |
|                                                                                                                                                                                                          |                      | Depth (m)                   | Type         | Results                                                                           |                                                                                                                                                                                    |                                                                                      |                                                                                   |                                                                                                                                             |                                                                                      |                                                                                                                             |  |
|                                                                                                                        |                      | 0.10                        | ES           |                                                                                   | 0.40                                                                                                                                                                               | 51.40                                                                                |  | Brown and orangish brown silty CLAY with brick fragments, tile fragments and some black stained decomposed organic material.<br>MADE GROUND |  |                                                                                                                             |  |
|                                                                                                                                                                                                          | 0.50<br>0.50<br>0.60 | D<br>PP<br>ES               | 4.3kg/cm2    |  |                                                                                                                                                                                    |                                                                                      | Brown silty CLAY with some rootlets and black flecking.<br>WEALD CLAY             |                                                                                                                                             |                                                                                      |                                                                                                                             |  |
|                                                                                                                                                                                                          | 1.00<br>1.00         | D<br>PP                     | 3.7kg/cm2    |  | Brown, pale grey and orangish brown silty slightly sandy CLAY with frequent ferruginous fragments and orange and black ferruginous staining.<br>WEALD CLAY<br><i>Some rootlets</i> |                                                                                      |                                                                                   |                                                                                                                                             |                                                                                      |                                                                                                                             |  |
|                                                                                                                                                                                                          | 1.50<br>1.50         | D<br>PP                     | 1.9kg/cm2    |  | 50.00                                                                                                                                                                              | Brown and pale bluish grey silty CLAY with some ferruginous fragments.<br>WEALD CLAY |                                                                                   |                                                                                                                                             |                                                                                      |                                                                                                                             |  |
|                                                                                                                                                                                                          | 2.00<br>2.00<br>2.10 | D<br>PP<br>ES               | 5.0kg/cm2    |                                                                                   |                                                                                                                                                                                    |                                                                                      |                                                                                   |                                                                                                                                             |                                                                                      |                                                                                                                             |  |
|                                                                                                                                                                                                          | 2.50<br>2.50         | D<br>PP                     | 4.9kg/cm2    |                                                                                   |                                                                                                                                                                                    |                                                                                      |                                                                                   |                                                                                                                                             |                                                                                      |                                                                                                                             |  |
|                                                                                                                                                                                                          |                      |                             | 2.90         | D                                                                                 |                                                                                                                                                                                    | 2.90                                                                                 | 48.90                                                                             |                                                          |                                                                                      | Brown and pale bluish grey silty CLAY with frequent tabular siltstone inclusions.<br>WEALD CLAY<br>End of Borehole at 2.90m |  |
|                                                                                                                                                                                                          |                      |                             |              |                                                                                   |                                                                                                                                                                                    |                                                                                      |                                                                                   |                                                                                                                                             |                                                                                      | 3                                                                                                                           |  |
|                                                                                                                                                                                                          |                      |                             |              |                                                                                   |                                                                                                                                                                                    |                                                                                      |                                                                                   |                                                                                                                                             |                                                                                      | 4                                                                                                                           |  |
|                                                                                                                                                                                                          |                      |                             |              |                                                                                   |                                                                                                                                                                                    |                                                                                      |                                                                                   |                                                                                                                                             |                                                                                      | 5                                                                                                                           |  |
| Dynamic Sampling Run Details                                                                                                                                                                             |                      | Water Strike Details (mbgl) |              | Remarks                                                                           |                                                                                                                                                                                    |                                                                                      |                                                                                   |                                                                                                                                             |                                                                                      |                                                                                                                             |  |
| Depth Top                                                                                                                                                                                                | Depth Base           | Diameter                    | Depth Strike | Rose To                                                                           | Refusal on hard layer                                                                                                                                                              |                                                                                      |                                                                                   |                                                                                                                                             |                                                                                      |                                                                                                                             |  |
|                                                                                                                                                                                                          |                      |                             |              |                                                                                   |                                                                                                                                                                                    |                                                                                      |                                                                                   |                                                                                                                                             |                                                                                      |                                                                                                                             |  |





**Image 1.** 1651658796026.jpg:  
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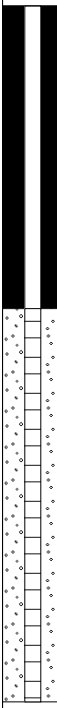
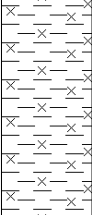
|  Unit 7, Danworth Farm<br>Hurstpierpoint<br>BN6 9GL<br>www.gesl.net                                                                                                                          |               |                            |      | <h1>Borehole Log</h1> |           |                            |                                                                                     | Borehole No.<br><b>WS05</b><br>Sheet 1 of 1                                                                    |  |
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| Project Name: North Horsham II                                                                                                                                                                                                                                               |               |                            |      | Project No. GE20724   |           | Co-ords: 519268E - 133415N |                                                                                     | Hole Type<br>WLS                                                                                               |  |
| Location: Horsham                                                                                                                                                                                                                                                            |               |                            |      | Level: 52.92          |           | Scale<br>1:25              |                                                                                     |                                                                                                                |  |
| Client: Legal & General                                                                                                                                                                                                                                                      |               |                            |      | Dates: 04/05/2022     |           | Logged By<br>KO            |                                                                                     |                                                                                                                |  |
| Well                                                                                                                                                                                                                                                                         | Water Strikes | Sample and In Situ Testing |      |                       | Depth (m) | Level (m)                  | Legend                                                                              | Stratum Description                                                                                            |  |
|                                                                                                                                                                                                                                                                              |               | Depth (m)                  | Type | Results               |           |                            |                                                                                     |                                                                                                                |  |
|                                                                                                                                                                                            |               | 0.20                       | ES   |                       | 0.30      | 52.62                      |    | Grass overlying brown silty CLAY with frequent rootlets and some black ferruginous fragments. TOPSOIL          |  |
|                                                                                                                                                                                                                                                                              |               | 0.50                       | D    |                       |           |                            |    | Brown and pale grey mottled silty CLAY with some orange. WEALD CLAY                                            |  |
|                                                                                                                                                                                                                                                                              |               | 0.60                       | ES   |                       |           |                            |    | <i>Some rootlets</i>                                                                                           |  |
|                                                                                                                                                                                                                                                                              |               | 1.00                       | D    |                       | 1.60      | 51.32                      |    |                                                                                                                |  |
|                                                                                                                                                                                                                                                                              |               | 1.50                       | D    |                       |           |                            |   | Orangish brown mottled silty CLAY with occasional fine to coarse sub-angular weakly cemented silts. WEALD CLAY |  |
|                                                                                                                                                                                                                                                                              |               | 1.90                       | ES   |                       |           |                            |  |                                                                                                                |  |
|                                                                                                                                                                                                                                                                              |               | 2.00                       | D    |                       | 2.10      | 50.82                      |  | Brown brown slightly sandy, clayey weakly cemented SILT with occasional thin siltstone bands. WEALD CLAY       |  |
|                                                                                                                                                                                                                                                                              |               | 2.30                       | D    |                       | 2.30      | 50.62                      | End of Borehole at 2.30m                                                            |                                                                                                                |  |
| <div> <div> <div>Dynamic Sampling Run Details</div> <div> <div>Depth Top</div> <div>Depth Base</div> <div>Diameter</div> </div> </div> <div> <div>Water Strike Details (mbgl)</div> <div> <div>Depth Strike</div> <div>Rose To</div> </div> </div> </div> <div>Remarks</div> |               |                            |      |                       |           |                            |                                                                                     |                                                                                                                |  |
| Refusal at 2.3m bgl on hard layer.                                                                                                                                                                                                                                           |               |                            |      |                       |           |                            |                                                                                     |                                                                                                                |  |





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Geo-Environmental

Unit 7, Danworth Farm  
Hurstpierpoint  
BN6 9GL  
www.gesl.net

# Borehole Log

Borehole No.

**WS06**

Sheet 1 of 1

Project Name: North Horsham II

Project No.  
GE20724

Co-ords: 520413E - 133674N

Hole Type  
WLS

Location: Horsham

Level: 64.37

Scale  
1:25

Client: Legal &amp; General

Dates: 16/05/2022

Logged By  
KO

| Well                         | Water Strikes | Sample and In Situ Testing  |               |           | Depth (m) | Level (m)                                                                | Legend | Stratum Description                                                               |   |   |   |
|------------------------------|---------------|-----------------------------|---------------|-----------|-----------|--------------------------------------------------------------------------|--------|-----------------------------------------------------------------------------------|---|---|---|
|                              |               | Depth (m)                   | Type          | Results   |           |                                                                          |        |                                                                                   |   |   |   |
|                              |               | 0.10                        | ES            | 4.3kg/cm2 | 0.30      | 64.07                                                                    |        | Brown silty clay with frequent rootlets and some decomposed rootlets. TOPSOIL     | 1 |   |   |
|                              |               | 0.50<br>0.50<br>0.70        | D<br>PP<br>ES |           |           |                                                                          |        | Very stiff orangish brown and pale grey silty CLAY with some rootlets. WEALD CLAY |   |   |   |
|                              |               | 1.00                        | D             |           |           | Brown and pale grey silty CLAY with rare siltstone fragments. WEALD CLAY |        | 2                                                                                 |   |   |   |
|                              |               | 1.50                        | D             |           |           |                                                                          |        |                                                                                   |   |   |   |
|                              |               | 1.80                        | ES            |           |           |                                                                          |        |                                                                                   |   |   |   |
|                              |               | 2.00                        | D             |           |           |                                                                          |        |                                                                                   |   |   |   |
|                              |               | 2.40                        | D             |           |           |                                                                          |        |                                                                                   |   |   |   |
|                              |               | End of Borehole at 2.40m    |               |           |           |                                                                          |        |                                                                                   | 3 |   |   |
|                              |               |                             |               |           |           |                                                                          |        |                                                                                   |   | 4 |   |
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|                              |               |                             |               |           |           |                                                                          |        |                                                                                   |   |   |   |
| Dynamic Sampling Run Details |               | Water Strike Details (mbgl) |               | Remarks   |           |                                                                          |        |                                                                                   |   |   |   |
| Depth Top                    | Depth Base    | Diameter                    | Depth Strike  | Rose To   |           |                                                                          |        |                                                                                   |   |   |   |
|                              |               |                             |               |           |           |                                                                          |        |                                                                                   |   |   |   |





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WindowSamplerPhoto

|  Unit 7, Danworth Farm<br>Hurstpierpoint<br>BN6 9GL<br>www.gesl.net |               |                             |              | <h1 style="text-align: center;">Borehole Log</h1>                              |              |                            |                                                                                                                                                                                     | Borehole No.<br><b>WS07</b><br>Sheet 1 of 1                                                                                      |   |                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------|--------------|--------------------------------------------------------------------------------|--------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------|
| Project Name: North Horsham II                                                                                                                      |               |                             |              | Project No. GE20724                                                            |              | Co-ords: 519575E - 133740N |                                                                                                                                                                                     | Hole Type<br>WLS                                                                                                                 |   |                                                                                                              |
| Location: Horsham                                                                                                                                   |               |                             |              | Level: 55.84                                                                   |              | Scale<br>1:25              |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
| Client: Legal & General                                                                                                                             |               |                             |              | Dates: 20/05/2022                                                              |              | Logged By<br>KO            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
| Well                                                                                                                                                | Water Strikes | Sample and In Situ Testing  |              |                                                                                | Depth (m)    | Level (m)                  | Legend                                                                                                                                                                              | Stratum Description                                                                                                              |   |                                                                                                              |
|                                                                                                                                                     |               | Depth (m)                   | Type         | Results                                                                        |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
|                                                                                                                                                     |               | 0.10                        | ES           | 3.2kg/cm2                                                                      | 0.40         | 55.44                      |                                                                                                                                                                                     | Grass overlying brown silty sandy slightly gravelly clay with abundant rootlets and some black ferruginous fragments.<br>TOPSOIL | 1 |                                                                                                              |
|                                                                                                                                                     |               | 0.50                        | D            |                                                                                | 0.50<br>0.60 | 0.80                       |                                                                                                                                                                                     | 55.04                                                                                                                            |   | Very stiff brown silty sandy CLAY with frequent black ferruginous fragments and some rootlets.<br>WEALD CLAY |
|                                                                                                                                                     |               | PP                          |              |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
|                                                                                                                                                     |               | ES                          | 1.8kg/cm2    | 1.00<br>1.00                                                                   | 1.60         | 54.24                      | Firm to stiff orangish brown becoming pale grey silty sandy CLAY with black ferruginous fragments, orange staining and some rootlets.<br>WEALD CLAY                                 |                                                                                                                                  |   |                                                                                                              |
|                                                                                                                                                     |               | D                           |              |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
|                                                                                                                                                     |               | PP                          |              |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
|                                                                                                                                                     |               | 1.50                        | D            | 0.8kg/cm2                                                                      | 2.00<br>2.00 | 53.24                      | Very stiff orangish brown very sandy gravelly CLAY with frequent black ferruginous fragments. Sand is fine to coarse. Gravel is fine to medium sub angular sandstone.<br>WEALD CLAY | 2                                                                                                                                |   |                                                                                                              |
|                                                                                                                                                     |               | PP                          |              |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
|                                                                                                                                                     |               | 2.50                        | D            | 4.3kg/cm2                                                                      | 2.60         | 53.24                      | Very stiff dark bluish grey and brown silty sandy CLAY with orange staining.<br>WEALD CLAY                                                                                          | 3                                                                                                                                |   |                                                                                                              |
|                                                                                                                                                     |               | PP                          |              |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
| ES                                                                                                                                                  | 4.2kg/cm2     | 3.00<br>3.00                | 52.74        | Brown and bluish grey interbedded silty CLAY and weak siltstone.<br>WEALD CLAY |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
| D                                                                                                                                                   |               |                             |              |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
| PP                                                                                                                                                  |               |                             |              |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
| 3.50                                                                                                                                                | D             | 4.00                        | 51.84        | End of Borehole at 4.00m                                                       | 4            |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
| D                                                                                                                                                   |               |                             |              |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
| 4.00                                                                                                                                                | D             |                             |              |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  | 5 |                                                                                                              |
| Dynamic Sampling Run Details                                                                                                                        |               | Water Strike Details (mbgl) |              | Remarks                                                                        |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |
| Depth Top                                                                                                                                           | Depth Base    | Diameter                    | Depth Strike |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   | Rose To                                                                                                      |
|                                                                                                                                                     |               |                             |              |                                                                                |              |                            |                                                                                                                                                                                     |                                                                                                                                  |   |                                                                                                              |

