

Phase II Site Investigation Report

Site: Phase 1c Northern Arc, Isaac's Lane, Burgess Hill, West Sussex RH15 8RA

On behalf of Hill Partnerships Limited

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EXECUTIVE SUMMARY	
PROPOSED DEVELOPMENT	At the time of reporting, August 2026, the proposed development was understood to comprise the construction of up to 270 residential dwellings and extra care units; commercial floorspace; the community building, the neighbourhood square, cycle and pedestrian connections, parking and associated infrastructure. The north-east will also comprise open space, multi-use games areas (MUGA), public art, green circle cycle link and associated infrastructure.
GEOLOGY AND HYDROGEOLOGY	The site was underlain by bedrock deposits of the Weald Clay Formation with superficial Alluvium recorded along the eastern boundary only. The majority of the site was anticipated to be mudstone with a band of ironstone noted in the northern portion and two bands of the Horsham Stone Member (sandstone) also shown to intersect the northern area. No areas of Made Ground or Reworked Ground were noted within a 250m radius. The site was underlain by a Secondary A Aquifer comprising the superficial Alluvium in the east, underlain by a Secondary A Aquifer comprising the bedrock Horsham Stone Member and Unproductive Strata comprising bedrock Weald Clay Formation. The site did not fall within a Groundwater Source Protection Zone (SPZ). The nearest surface water feature was Holmbush Gill adjacent to the east and intersecting the north-eastern portion of the site. The groundwater table was anticipated to be encountered at depth below the Weald Clay Formation. Some amounts of perched water however may be present at shallower depths within Made Ground, parts of the Alluvium or in the siltstone/sandstone of the Weald Clay Formation/Horsham Stone Member. It was considered that groundwater was flowing in a south/south-easterly direction toward the stream and in line with local topography.
VOLUME CHANGE POTENTIAL	At this stage foundations should be designed in accordance with soils of high volume change potential. Further testing could be undertaken to zone plots as 3 out of the 4 samples tested were medium volume change potential (VCP) (BH1, BH2 and BH4) with BH3 being high vcp all within the weathered mudstone clays.
FOUNDATION DESIGN	Foundations constructed at 1.00m bgl can be designed based on a presumed allowable bearing capacity of 110 – 150kN/m ² . This is based on trial hole records, the results of in-situ testing, inspection of samples recovered, and referral to BS 8004:2015, Code of Practice for Foundations, and based on a 5m long by 1m wide foundation and a maximum settlement of 25mm. Settlement loading are likely to be moderate to high.
SUB-SURFACE CONCRETE	DS-1, AC-1 in Made Ground and Topsoil. Due to the lower pH in TP17/0.20 (Topsoil) upped to DS-1, AC-2z. Weald Clay - DS-2, AC-3z.
CONTAMINATION	One contaminant (arsenic) has been found at an unacceptable concentration within the natural ground which requires remediation. An Asbestos Management Strategy should be put in place so that any potentially asbestos containing materials are identified and removed from site in a suitable manner to prevent cross-contamination.
REMEDIATION	Watching brief with arsenic testing at formation level if ironstone identified and subsequent remediation if >37/mg/kg. Further details in Section 8.1.

1. INTRODUCTION

1.1. General

Ground and Water Limited were instructed by Hill Partnerships Limited (the Client) on the 6th May 2026 to conduct a Phase II Site Investigation on the site at Phase 1c Northern Arc, Isaac's Lane, Burgess Hill, West Sussex RH15 8RA (the Site). The scope of the investigation was detailed within the fee proposal QU-2511v3, dated the 30th April 2026.

1.2. Aims of the Investigation

The aim of this report was to supply the client and their designers with information regarding the ground conditions underlying the site to assist them in preparing an appropriate scheme for development.

The investigation was to be undertaken to provide parameters for the design of foundations by means of in-situ and laboratory geotechnical testing undertaken on soil samples recovered from trial holes.

A contamination assessment was to be undertaken following chemical laboratory testing on soil samples recovered from the site to enable recommendations for the safe redevelopment of the site and the protection of site workers, end-users and the public from any potential contamination identified. The assessment comprises a Tier 2 Generic Quantitative Risk Assessment, under Land Contamination Risk Management (LCRM), with the intention of discharging planning conditions.

This Site Investigation Report must be read in conjunction with the Desk Study Report referenced GWPR7060/DS/July 2026.

The techniques adopted for the investigation were chosen considering the requirements of the client, anticipated ground conditions, and bearing in mind the nature of the site, limitations to site access and other logistical limitations.

1.3. Conditions and Limitations

This report has been prepared based on the terms, conditions and limitations outlined within Appendix A.

Ground and Water Limited were provided with Cambell Reith factual reports for:

- Phase 1.2 ref: 13258-CRH-XX-XX-RP-GE-0019 Rev F2, October 2020
- Phase 1.7 ref: 13258-CRH-XX-XX-RP-GE-0023 Rev F2, October 2020
- Phase 1.8 ref: 13258-CRH-XX-XX-RP-GE-0024 Rev F1, October 2020

Reference has been made to a historical site investigation by another company. Ground and Water Limited cannot be held liable for any shortcomings and the reports are being used for information purposes only and will not be relied upon.

This version of the report supersedes the previous version and includes additional chemical testing and remediation strategy.

1.4. Technical Glossary

Generic technical terms and their description can be viewed within the glossary provided within Appendix B.

2. SITE SETTING

2.1. Site Location

The site comprised a ~12.85ha irregular-shaped plot of land, along the eastern side of Issac's Lane (A273), accessed via Holmbush Avenue. The site is made up of three parcels which make up Parcel 1c of the Northern Arc project. This includes a roughly rectangular shaped plot east of Issac's Lane and north of Holmbush Avenue, a smaller rectangular parcel (south of the first one) which is east of Issac's Lane and south of Holmbush Avenue and a much larger irregular shaped parcel, where the southern section is adjacent to the east of Isaac's Lane and north-western section is west and south of Holmbush Avenue. The site was located in the north portion of Burgess Hill, a town and civil parish in West Sussex.

The Easting Northing for the centre of the site was approximately 530979, 120758. A site location plan is given within Figure 1.

2.2. Site Description

A Site Walkover was undertaken on the 12th June 2026. A description of the site, as noted during the Site Walkover, is tabulated below.

Site Description Sheet	
Use of site	At the time of the site walkover, 12 th June 2026, the site was predominantly multiple open soft landscape fields. Access roads were noted through the centre of the site running west to east, and then up north through the sites centre. A SISK site office was also noted in the centre/west portion of the site.
Site topography	The site was sloping gently from the north down to the south.
Area topography	The area was relatively flat, however also sloping from the north down to the south.
Structures onsite	No structures were noted on-site, only the temporary SISK site offices in the centre, western portion of the site. SISK were constructing a small building which wasn't complete at the time of site walkover. An underground buried structure, suspected to be a sewage feature, appears to have been installed in close proximity to the site compound, it is understood that this is a temporary feature and is not part of the proposed development.
Structures off-site	A medium sized residential development was noted just north of the site, with access roads and associated site offices.
Use of surrounding ground	Residential, along with open agricultural fields.
Boundary features	Northern Boundary: Open to the northern residential development. Eastern Boundary: Mainly trees/bushes, however a small river noted on the sit boundary in the northeastern corner. Southern Boundary: Trees and bushes, leading to a large public road. Western Boundary: Trees and bushes, leading to a large public road.
Site covering	The majority of the site was covered by soft landscape, apart from the access roads running west to east, and then up north through the sites centre. The SISK site office was also noted in the centre/west portion of the site, which had some associated hardstanding.
Contamination sources onsite	Possible Made Ground associated with the building works at the SISK portion of the site, along with Made Ground associated with the northern residential development, some building materials were noted to be dumped in the northern section of the site, shown within Appendix C page 5.
Contamination sources off-site	None noted.
Vegetation onsite	Mature to semi-mature trees, bushes, shrubs and abundant grass.

Vegetation off-site	Mature to semi-mature trees, bushes, shrubs.
Services	Services being diverted and put in place within the road running through the centre of the site. A high voltage cable was noted to have just been placed within a soft landscape area of the site, running from the previously constructed road and running south into the field. Possible services relating to the SISK site noted in their area.

2.3. Proposed Development

At the time of reporting, August 2026, the proposed development was understood to comprise the construction of up to 270 residential dwellings and extra care units; commercial floorspace; the community building, the neighbourhood square, cycle and pedestrian connections, parking and associated infrastructure. The north-east will also comprise open space, multi-use games areas (MUGA), public art, green circle cycle link and associated infrastructure.

The proposed illustrative masterplan can be seen within Figure 2.

2.4. Geology

The British Geological Survey Solid and Drift Geology Map for the Burgess Hill area (Brighton & Worthing Sheet No. 318/333) revealed that the site was underlain bedrock deposits of the Weald Clay Formation with superficial Alluvium recorded along the eastern boundary only. The majority of the site was anticipated to be mudstone with a band of ironstone noted in the northern portion and two bands of the Horsham Stone Member (sandstone) also shown to intersect the northern area. There was also a fault shown to intersect the centre of the site. No areas of Made Ground or Reworked Ground were noted within a 250m radius.

A BGS borehole (TQ32SW54) located ~200m east of the site revealed a 0.50m capping of Made Ground containing ash and clinker overlying a stiff to very stiff fissured brown and grey silty CLAY to 8.20m bgl over a very stiff blue and grey silty CLAY becoming mudstone towards the base of the borehole at 10.00m bgl both indicative of the Weald Clay Formation. No groundwater was encountered.

2.5. Hydrogeology and Hydrology

A study of the aquifer maps on the DEFRA website revealed the majority of the site was underlain by **Unproductive Strata** comprising bedrock Weald Clay Formation, a **Secondary A Aquifer** comprising the superficial Alluvium in the east and a **Secondary A Aquifer** comprising the bedrock Horsham Stone Member.

Examination of the Environment Agency records showed that the site **did not** fall within a Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water feature was Holmbush Gill which was flowing in a southerly direction and was located adjacent to the southern and eastern boundary and intersecting the site in the north-eastern corner.

From analysis of hydrogeological and topographical maps the actual groundwater table was anticipated to be encountered at depth below the Weald Clay Formation. Some amounts of perched water however may be present at shallower depths within Made Ground, parts of the Alluvium or in the siltstone/sandstone of the Weald Clay Formation/Horsham Stone Member. It was considered that

groundwater was flowing in a south/south-easterly direction toward the stream and in line with local topography.

Examination of the Environment Agency records showed that the site was located within a Flood Zone 1 for the majority of the site, i.e. an area with a very low probability of flooding. Although the eastern boundary and north-eastern portion is in a Flood Zone 2 and 3, no proposed buildings are within these zones.

The Groundsure Datasheets revealed the site was at a high risk of flooding from rivers and the sea for the eastern section of the site adjacent to the river, the majority of the site was not at risk. The majority of the site was not at risk of surface water or groundwater flooding, however, the north-eastern portion and eastern boundary were at a high risk.

2.6. Radon

A review of the freely available UK Health Security Agency radon database, UK Radon, indicated that the site was located within a 1km grid square, where the maximum radon potential of <1% was recorded for above ground structures. Basic radon protection measures are required in areas where more than 3% of houses are at or above the Action Level.

The site was in an area where a risk assessment was not required.

2.7. Internet Search (Site Setting)

2.7.1. Available Unexploded Ordnance (UXO) Map Review

A review of the data available on www.zeticauxo.com/ revealed the site was located within a low -risk area associated with unexploded ordnance (UXO), as indicated by having <15 bombs dropped per 1000 acres. No UXO finds were recorded within a 1km radius. Therefore, no further risk assessment is required with respect of UXO.

2.7.2. Historical Landfill Tool Review

A review of the data available on www.groundsure.io/ did not reveal an area of historical landfilling within a 250m radius.

2.8. Preliminary Risk Assessment

The tabulated Conceptual Site Model developed as part of the Ground and Water Ltd Desk Study (GWPR7060/DS/July 2026) is outlined overleaf. For ease of reference and understanding, the risks have been classified within this risk assessment against four possible levels / categories, summarised in the table below. Any risk deemed to be negligible within the Preliminary Risk Assessment have been excluded from this report.

Risk Categories used in the Tabulated CSM	
Low Risk	Regarding this potential SPR linkage, the site is considered suitable for the proposed end-use and there is not considered to be an unacceptable risk to receptors. However, it is considered that further investigation to confirm this is recommended.
Moderate Risk	Regarding this potential SPR linkage, the site may not be suitable for the proposed end-use in its current condition and there may be an unacceptable risk to receptors. Further investigation is required to confirm this.
High Risk	Regarding this potential SPR linkage, the site is probably or certainly not suitable for proposed end-use and there is likely to be an unacceptable risk to receptors. Contaminants probably or certainly present and urgent action required in the short term.

Tabulated Conceptual Site Model – Pollutant Linkage Summary				(On-Site Sources)	Risk Classification
Potential Sources	Potential Absorption Pathways	Potential Receptors			
Made Ground from site compound in NW and ground workings in NE: - Asbestos, - PAHs, - TPHs, - VOCs, - Sulphates, and - Metals, particularly arsenic where ironstone band is.	- Direct ingestion of soil and soil derived dust - Dermal contact of soil and soil derived dust - Inhalation of dust (indoors and outdoors) with elevated concentration of determinands - Ingestion of home-grown produce, and soils attached - Direct ingestion of groundwater - Inhalation of volatile vapour (indoors and outdoors) - Direct uptake of groundwater - Direct uptake of determinands in the soil - Anthropogenic (man-made) pathways - Vertical and lateral migration in permeable strata - Surface water runoff	Human Health - End Users (Residents/Future site visitors) - Construction workers during development - Site operatives during maintenance works - Neighbours and public	Moderate		
		Flora and Fauna Vegetation within soft landscaped areas			
		Controlled Waters - Secondary A Aquifer (Alluvium and Horsham Stone Member) - River Holmbush Gill	Low		
Aggressive ground conditions with Made Ground and natural ground, including groundwater: Sulphates,	Direct contact with aggressive ground conditions	Building Materials and Services Buried Concrete			
Aggressive ground conditions with Made Ground and natural ground, including groundwater: PAH/TPH.	Direct contact with aggressive ground conditions	Building Materials and Services Underground services (water pipes)	Low		
Ground gases generated by Alluvium Deposits: - Methane, - Carbon Dioxide, - Hydrogen Sulphide, and - Carbon Monoxide.	- Migration through anthropogenic & natural pathways - Inhalation of Asphyxiating gases - Explosion (methane only)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development (especially in confined spaces) - Site operatives during maintenance works in confined spaces - Neighbours and public			
	- Migration through anthropogenic & natural pathways - Explosion (methane only)	Building Materials and Services - Buildings - Confined spaces - Underground services	Low (east only)		

3. SITE WORKS

3.1. Scope of Works

Site works were undertaken on the 26th May – 3rd June 2026 and comprised the drilling of the 5No. Rotary Boreholes to 20.70m bgl (BH1), 20.80m bgl (BH5), 30.10m bgl (BH3), 34.20m bgl (BH2) and 35.00m bgl (BH4) with standard penetration tests at 1.00m intervals to 5.00m bgl and every 1.50m thereafter until two consecutive refusals. Additionally, between 26th – 29th May 2026, 19No. Trial Pits (TP1 – TP19) were machine excavated to depths of between 1.00 – 2.60m bgl.

The location of the trial hole locations can be seen within Figure 3.

Prior to commencing the ground investigation, a walkover survey was carried out to identify the presence of underground services and drainage. Where underground services/drainage were suspected and/or positively identified, the exploratory position was relocated away from these areas.

As a further precautionary measure, the borehole was hand excavated to 1.20m below the local ground level (bgl) and scanned with a Cable Avoidance Tool (CAT scanner) to minimise the risk to services.

Upon completion of the drilling works, the trial holes were backfilled and made good, in relation to the surrounding area.

3.2. Sampling Procedures

Small disturbed samples and environmental samples were recovered from the trial holes at the depths shown on the trial hole records. Soil samples were generally retrieved from each change of strata and/or at specific areas of concern. Samples were also taken at approximately 0.5m intervals during broad homogenous soil horizons.

A selection of samples were despatched to a UKAS accredited laboratory for both geotechnical and chemical testing purposes.

4. ENCOUNTERED GROUND CONDITIONS

4.1. Soil Conditions

The trial holes were logged by a Ground and Water Limited representative, generally in accordance with BS EN 14688 'Geotechnical Investigation and Testing – Identification and Classification of Soil'. Any rock or weathered rock samples were logged in accordance with BS EN 14689 'Geotechnical Investigation and Testing – Identification and Classification of Rock'.

The ground conditions encountered within the trial holes constructed on the site did generally conform to that anticipated from examination of the geology map. A capping of Made Ground was noted to overlie localised superficial Alluvium and the bedrock Weald Clay Formation.

The succession of conditions and description of soils encountered in the trial holes in descending order is tabulated below.

Summary of Strata Encountered			
Strata	Top Depth (m bgl)	Base Depth (m bgl)	Thickness (m)
MADE GROUND: Light greyish brown slightly gravelly silty CLAY. Gravel is angular to sub-angular, fine to medium, flint, brick, chalk, limestone, plastic and ceramics. <i>(TP1, TP2, TP9, TP11, TP13, TP14, TP16, TP19, BH1, BH4, BH5)</i>	GL	0.15 – 1.00	0.15 – 1.00
TOPSOIL: Light greyish brown slightly clayey gravelly SILT. Gravel is angular, fine to medium, flint. <i>(TP3 – TP6, TP10, TP12, TP15, TP17, TP18, BH2, BH3)</i>	GL	0.15 – 0.40	0.15 – 0.40
MADE GROUND: Type 1 SUBBASE over geotextile membrane. <i>(TP7 - TP9)</i>	GL – 1.00	0.50 – 1.20	0.20 – 0.60
ALLUVIUM: Very stiff dark brown CLAY. Mild organic odour. <i>(TP11, BH4)</i>	0.25 – 0.35	0.60	0.25 – 0.35
COHEISVE WEATEHRED WEALD CLAY FORMATION: Orangish brown and brown silty CLAY/clayey SILT. <i>(TP1 – TP10, TP12 - TP19, BH1 – BH5)</i> . Locally with black speckling and mottled blue and with occasional angular fine to medium ironstone/sandstone/mudstone/siltstone fragments.	0.15 – 1.20	0.50 – 4.70	>0.30 – 4.10
GRANULAR WEATEHRED WEALD CLAY FORMATION: Recovered as loose light brown slightly silty clayey sub-angular to angular, fine to coarse, GRAVEL of ironstone and siltstone. <i>(TP10)</i>	0.50	>1.00	>0.50
GRANULAR WEATHERED WEALD CLAY FORMATION: Recovered as loose light brown and grey gravelly fine to coarse SAND. Gravel is sub-angular to angular, fine to coarse, weak sandstone. <i>(TP11, BH5)</i>	0.60 – 13.70	>1.00 – 14.00	0.30 – >0.40
WEALD CLAY FORMATION: Very weak to moderately strong dark grey to light grey interbedded MUDSTONE, SILTSTONE and SANDSTONE. <i>(BH1 – BH5)</i> . Details on fractures and spacing can be seen on the full logs in Appendix C.	1.20 – 14.00	13.70 - >35.00	6.80 - >30.30

For details of the composition of the soils encountered at particular points, reference must be made to the individual trial hole logs within Appendix C of this report. A trial hole location plan can also be viewed within Figure 3.

4.2. Roots Encountered

No roots were noted during the intrusive investigation.

It must be noted that the chance of determining actual depth of root penetration through a narrow diameter borehole is low. Roots may be found to greater depths at other locations on the site, particularly close to trees and/or trees that have been removed both within the site and its close environs.

4.3. Groundwater Conditions

A groundwater strike was encountered at 10.50m bgl in BH5. No other locations recorded groundwater strikes during the intrusive investigation. It should be noted that groundwater strikes may have been obscured by the drilling process.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was undertaken between May and June 2026 when groundwater levels are likely to be approaching their annual minimum (lowest elevation). Exact groundwater levels may only be determined through long term measurements from monitoring wells installed on-site.

4.4. Obstructions

No artificial or natural sub-surface obstructions were noted during construction of the trial holes.

5. IN-SITU AND LABORATORY TESTING

5.1. In-situ Strength Testing

Standard Penetration Tests (SPTs) were undertaken as part of the site investigation. The results of the SPT's have not been amended to consider hammer efficiency, rod lengths and overburden pressure in accordance with Eurocode 7. The test results are presented on the borehole logs within Appendix C. An interpretation of the in-situ geotechnical testing results is given in the table below.

Interpretation of In-situ Geotechnical Testing Results				
Strata	SPT "N" Blow Counts	Equivalent Undrained Shear Strength (Cu) (kPa)	Cohesive (Cu) Soil Type	Trial Hole/s
Weathered Weald Clay Formation (Cohesive)	11 – 50	55 – 250	Medium to Very High	BH1/1.20 – 3.10m bgl BH2/1.20 – 2.70m bgl BH3/1.20 – 2.42m bgl BH4/1.20 – 3.50m bgl BH5/1.20 – 2.20m bgl
Weald Clay Formation (Rock)	42 – 50	-	-	BH1/3.10 – 20.70m bgl BH2/2.70 – 34.20m bgl BH3/2.42 – 30.10m bgl BH4/3.50 – 35.00m bgl BH5/2.20 – 20.80m bgl

It must be noted that field measurements of undrained shear strength (Cu) are dependent on a number of variables including disturbance of sample, method of investigation and also the size of specimen or test zone.

5.2. Geotechnical Laboratory Testing

A programme of geotechnical laboratory testing, scheduled by Ground and Water Limited and carried out by an accredited geotechnical testing laboratory was undertaken on samples recovered. Details of the specific tests used in each case are given below.

Standard Methodology for Laboratory Geotechnical Testing		
Test	Standard	Number of Tests
Atterberg Limit Tests	BS1377:2016:Part 2:Clauses 3.2, 4.3 & 5	4
Determination of Point Load Value Axial or Diametrical, including WC	ISRM Suggested Method for Point Load Strength	11
BRE Special Digest 1 Tests	BRE Special Digest 1 "Concrete in Aggressive Ground (BRE, 2005).	4

5.2.1. Atterberg Limit Testing

A précis of Atterberg limit testing undertaken can be seen tabulated overleaf. The test results are presented within Appendix D.

Atterberg Limit Tests Results Summary							
Stratum	Moisture Content (%)	Passing 425 µm sieve (%)	Modified PI (%)	Soil Class	Consistency Index (Ic)	Volume Change Potential	
						BRE	NHBC
Weald Clay Formation – <i>BH1/2.85-3.10</i> <i>BH2/1.40-4.55</i> <i>BH4/1.90-2.05</i>	18.4	100	36 - 39	CH	Stiff	Medium	Medium
Weald Clay Formation – <i>BH3/2.50-2.65</i>	16.7 – 17.6	100	41	CH	Stiff	High	High
• NP – Non-plastic • BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results) • Soil Classification based on British Soil Classification System. • Consistency Index (Ic) based on BS EN ISO 14688-2:2018.							

5.2.2. Moisture Deficit Assessment

The results of the Atterberg Limit tests were analysed to determine the Liquidity Index of the samples, to give an indication as to whether the samples recovered showed a moisture deficit as well assessing their degree of consolidation. Liquid Limit analyses was undertaken to assess whether there were any potentially significant moisture deficits within the samples tested.

A potential moisture deficit, caused by lithology was noted within all samples tested.

5.2.3. Point Load Testing

Point Load Testing was undertaken on core samples from BH1 – BH5 to determine the point load strength of the rock underlying the site and a summary of the results are tabulated below.

Point Load Testing Results Summary							
BH/Depth (m bgl)	Platen Separation (mm)	Failure Load (kN)	Point Load (MPa)	Size Factor	Point Load Index – I _s (50) (MPa)	Moisture Content (%)	Description
BH1/7.79 – 7.85	89	1.15	0.15	1.30	0.19	9.6	Mudstone
BH1/17.26 – 17.40	91	0.53	0.07	1.26	0.09	10.5	Mudstone
BH2/5.59 – 5.70	89	0.42	0.05	1.30	0.07	8.0	Mudstone
BH2/16.20 – 16.32	49	0.53	0.10	1.20	0.11	8.9	Mudstone
BH2/32.32 – 32.47	89	0.39	0.05	1.30	0.06	7.0	Mudstone
BH3/12.10 – 12.26	51	0.25	0.04	1.21	0.05	8.9	Mudstone
BH3/23.05 – 23.26	89	0.64	0.08	1.30	0.10	10.2	Mudstone
BH4/20.31 – 20.43	89	1.26	0.16	1.30	0.21	9.1	Mudstone
BH4/31.05 – 21.23	89	0.61	0.08	1.30	0.10	6.3	Mudstone
BH5/4.3 – 4.50	89	0.55	0.07	1.30	0.09	11.6	Mudstone
BH5/13.90 – 14.10	89	0.29	0.04	1.30	0.05	8.6	Mudstone

A commonly used empirical relationship for estimating Uniaxial Compressive Strength (UCS) from Point Load Testing suggests:

$$UCS \approx K \times I_s(50). \text{ Where } K \text{ is an empirical factor.}$$

K is typically in the range of 15 – 25 depending on the rock type based on papers such as Franklin, J. A. & Broch, E. (1972) and Z. T. Bieniawski (1975). To be conservative given the known weather nature of the Weald Clay Formation mudstone K = 15 will be utilised.

Point Load Testing Results Summary			
BH/Depth (m bgl)	Point Load Index – I _s (50) (MPa)	Estimated UCS (MPa)	Strength Class*
BH1/7.79 – 7.85	0.19	2.85	Very Weak
BH1/17.26 – 17.40	0.09	1.35	Very Weak
BH2/5.59 – 5.70	0.07	1.05	Very Weak
BH2/16.20 – 16.32	0.11	1.65	Very Weak
BH2/32.32 – 32.47	0.06	0.90	Extremely Weak
BH3/12.10 – 12.26	0.05	0.75	Extremely Weak
BH3/23.05 – 23.26	0.10	1.50	Very Weak
BH4/20.31 – 20.43	0.21	3.15	Very Weak
BH4/31.05 – 21.23	0.10	1.50	Very Weak
BH5/4.3 – 4.50	0.09	1.35	Very Weak
BH5/13.90 – 14.10	0.05	0.75	Extremely Weak
*Classification in accordance with BS 5930:2015+A1:2020.			

6. ENGINEERING CONSIDERATIONS

6.1. Soil Characteristics and Foundation Considerations

A summary of the soil characteristics following the intrusive site investigation and laboratory testing and the relevant foundation considerations has been provided below. The following information from the ground investigation was considered pertinent to the design of foundations.

- Foundations should be taken through any Topsoil/Made Ground/Alluvium and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.
- At this stage foundations should be designed in accordance with soils of high volume change potential. **Further testing could be undertaken to zone plots as 3 out of the 4 samples tested were medium volume change potential (VCP) (BH1, BH2 and BH4) with BH3 being high vcp all within the weathered mudstone clays.**
- Given the presence of cohesive soils at shallow depth, special foundation precautions may be required to prevent possible future shrinkage/swelling of the soils affecting the integrity of the faces of foundations (underfloor void diameter/compressible material/void formers etc.). A compressible layer must be provided to accommodate potential seasonal movement, based on NHBC guidance.
- The design of each structural element (slab/piles/beams) should be designed in accordance with the appropriate volume change potential of the respective bearing stratum. Special foundation precautions may be required to prevent possible future shrinkage/swelling of the soils affecting the integrity of the faces of foundations and/or structural element (underfloor void diameter/compressible material/void formers etc.). Heave protection measures are also recommended for all structural elements of the design to account for the volume change potential of the respective stratum and heave resulting from any soil removal.
- The loads of proposed foundations should not exceed the allowable bearing capacity of the soils they are founding upon.
- Foundations must not be placed within fresh root penetrated and/or desiccated soils with volume change potential. It is recommended that foundations are taken at least 300mm into non-fresh root penetrated strata if the soils have volume change potential, or into soils of no volume change potential.
- The influence of trees on or surrounding the site will need to be taken into account in final design (NHBC Standards Chapter 4. 2) (tree rings).
- Any water ingress must be prevented from entering foundation trenches and excavations must be kept dry and either concreted or blinded as soon after excavation as possible. If water were allowed to accumulate within the excavation for even a short period of time, an increase in heave occur. The shear strength will also be reduced, resulting in lower bearing capacities, resulting in increased settlements. Instability issues may arise within the foundation trenches, in case of perched water being present.

6.2. Shallow Foundations

Foundations should be taken through any Topsoil/Made Ground, as well as bypassing any Alluvium, and be founded onto competent, moisture stable soils of the Weald Clay Formation. Due to the Weald Clay typically being cohesive having medium to high volume change potential, an absolute minimum foundation depth of 1.00m bgl should be applied; however, should fresh roots be encountered (e.g.

in close proximity to trees), foundations must extend 300mm beyond the proven depth of fresh root penetration into the cohesive soils.

Summary of Minimum Foundation Depths			
Trial Hole	Minimum Foundation Depth (m bgl)	Founding Geological Formation	Reason
BH1, BH2, TP1, TP2, TP3, TP4, TP5 (NW parcel)	1.00	Cohesive Weald Clay Formation	Foundations should bypass Made Ground/Topsoil and found on competent, moisture stable soils at least at the minimum depth recommended for high volume change potential.
BH3 (W parcel)	1.00	Cohesive Weald Clay Formation	Foundations should bypass Made Ground/Topsoil and found on competent, moisture stable soils at least at the minimum depth recommended for high volume change potential.
BH4 (E/S parcel)	1.00	Cohesive Weald Clay Formation	Foundations should bypass Made Ground/Alluvium and found on competent, moisture stable soils at least at the minimum depth recommended for high volume change potential.
BH5 (E/S parcel)	1.00	Cohesive Weald Clay Formation	Foundations should bypass Made Ground/Topsoil and found on competent, moisture stable soils at least at the minimum depth recommended for high volume change potential.
TP6, TP13, TP14, TP15, TP16, TP17, TP18, TP19 (E/S parcel)	1.00	Cohesive Weald Clay Formation	Foundations should bypass Made Ground/Topsoil and found on competent, moisture stable soils at least at the minimum depth recommended for high volume change potential.

Foundations constructed at 1.00m bgl can be designed based on a presumed allowable bearing capacity of 110 – 150kN/m². This is based on trial hole records, the results of in-situ testing, inspection of samples recovered, and referral to BS 8004:2015, Code of Practice for Foundations, and based on a 5m long by 1m wide foundation and a maximum settlement of 25mm. Settlement loading are likely to be moderate to high.

Additional Comments

A number of comments and recommendations has been provided below.

- It is prudent to avoid having a foundation spanning across materials of different consistency, like clay and gravel, in order to avoid potential differential settlements. If unavoidable, foundations must be reinforced to allow for such potential differential movement. It should be noted that differential settlement may also occur between strip and isolated pad foundations.
- Foundation excavations must be carefully bottomed out and any loose soil or soft spots removed prior to the foundation concrete or blinding being placed. Failure to ensure that foundation excavations are suitably bottomed out could result in additional settlements.
- Inspection of foundation excavations, prior to concreting, must be made by a competent and suitably qualified person to check for soft spots and to check for the presence of roots.

- Foundations must not be cast over foundations of former structures and/or other hard spots.
- Given soils of volume change potential were encountered and Topsoil/Made Ground was noted to be deeper than 0.60m bgl, a suspended slab is required.
- Isolated Pad Foundations must be at least 1.5 times the width of the widest pad apart to keep to the anticipated settlements.
- Final designs for the foundations should be carried out by a suitably qualified Engineer based on the findings of this investigation and with reference to the anticipated loadings, serviceability requirements for the structure and the developments proximity to former, present, and proposed trees. Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

6.3. Piled Foundation

Based on the results of the intrusive investigation, a piled foundation scheme was unlikely to be required. However, should higher loads be required for the larger structures a piled foundations scheme may be more appropriate.

The construction of a piled/minipile foundation is a specialist job, and the advice of a reputable contractor, familiar with the type of ground and groundwater conditions encountered on this site, should be sought prior to finalising the foundation design. The actual pile working load will depend on the particular type of minipile/pile and method of installation adopted.

The foundation would comprise a minipiled/piled foundation with reinforced ground beams or a piled slab. In general, for the cumulative pile capacity calculations, shaft friction over desiccated levels should be ignored and minipiles/piles should not be terminated within desiccated soils where moisture recovery following tree removal could occur.

Piling Groundwater Risk Assessment

If piling is utilised for foundations. As these may extend into the aquifer beneath the site, the potential for pathways to be present need to be considered.

Review of the Wilson and Mortimer paper *Piled foundations and pathways for ground gas migration in the UK* (ICE publishing – Environmental Geotechnics), indicates that any preferential pathways for ground gases or contaminated water created by piles needs consideration for ground conditions and the nature of the pile utilised.

An important consideration is the nature of the pile, whether it is a displacement or replacement pile. For there to be a preferential pathway for the movement of groundwater, a continuous open annulus is required around the piles installed. An open annulus will not form around piles during installation except for driven H and I piles. Cast in-situ piles are driven or bored and filled with wet concrete. The pressure exerted on the wet concrete will seal up any annulus around the pile, sealing any pathway.

The Environment Agency recommend that CFA piling is undertaken on any site where contamination may be expected.

Based on the above, the use of CFA piles or other cast in-situ piles should be adopted, which will not result in the downward migration of contamination within the groundwater.

6.4. Excavations and Stability

Shallow excavations in the Made Ground and Alluvium are likely to be marginally stable at best. Long, deep excavations, through these strata and into the underlying Weald Clay Formation are likely to become unstable.

Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported before excavations are entered by personnel.

6.5. Sub-Surface Concrete Design

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1, 2005, *'Concrete in Aggressive Ground'* considering the pH of the soils. For the classification given below, the "mobile" and "brownfield (NE only) and natural remainder of site" case was adopted given the geology encountered and the residential use of the site. This assessment was based on the results of laboratory testing summarised within Section 5, specifically relating to sulphates, pH and other water soluble chemicals.

Made Ground

The water-soluble sulphates in the Made Ground were noted to be 5.84 - 368mg/l, with a pH of 6.8 – 8.5, from chemical laboratory testing.

According to BRE Special Digest 1, 2005, *'Concrete in Aggressive Ground'* a Sulphate Design Class of DS-1 should be used for sub-surface concrete in contact with the Made Ground. Table C1 of the Digest indicated an ACEC (Aggressive Chemical Environment for Concrete) classification of AC-1.

Topsoil

The water-soluble sulphates in the Topsoil were noted to be 4.51 - 32.8mg/l, with a pH of 6.3 – 7.8, from chemical laboratory testing.

According to BRE Special Digest 1, 2005, *'Concrete in Aggressive Ground'* a Sulphate Design Class of DS-1 should be used for sub-surface concrete in contact with the Topsoil. Table C1 of the Digest indicated an ACEC (Aggressive Chemical Environment for Concrete) classification of AC-1. **However, due to the lower pH in TP17/0.20, anything in this vicinity would need to be upped to DS-1, AC-2z.**

Weald Clay Formation

The water-soluble sulphates in the Weald Clay Formation was noted to be 7.82 – 81.9mg/l, with a pH of 5.3 - 9, from chemical laboratory testing. The total potential sulphate (3x total sulphur) was 0.036 – 0.621%, from chemical laboratory testing.

According to BRE Special Digest 1, 2005, *'Concrete in Aggressive Ground'* a Sulphate Design Class of DS-2 should be used for sub-surface concrete in contact with the Weald Clay Formation. Table C1 of the Digest indicated an ACEC (Aggressive Chemical Environment for Concrete) classification of AC-3z.

It is prudent to note that pyrite nodules may be present within the Weald Clay Formation. Pyrite can oxidise to gypsum and this normally only occurs in the upper weathered layer, but excavation allows faster oxidation and water-soluble sulphate values can rapidly increase during construction. Therefore, rising sulphate values should be considered should ferruginous staining/pyrite nodules be encountered within the Weald Clay Formation.

6.6. Roads and Hardstanding Design

This section provides information relating to the construction of roads and hardstanding, for each strata encountered.

6.6.1. Anticipated CBR Values and Frost Susceptibility

Topsoil

Roads and hardstanding should bypass Topsoil given the likely low strength, high compressibility and general variability.

Made Ground

Where roads and hardstanding are to be founded on Made Ground, a CBR value of 1% should be adopted, as a result of the variable nature of Made Ground in terms of consistency, strength and compressibility.

Weald Clay Formation (cohesive)

Roads and hardstanding constructed on the cohesive Weald Clay Formation should be designed based on a CBR value of 2.5%. This is based on reference to Table C1 of TRL1132 and average construction conditions. Based on wet conditions a CBR of 2.0% should be adopted, with dry conditions a CBR of 2.5% being applicable.

These clay-based soils (poorly drained) with plasticity indexes generally greater than 20% are likely to be non-frost susceptible.

All formation levels for roads and hardstanding should be proof rolled to highlight any soft areas which should then be dug out and replaced with selected granular material compacted in thin layers to a suitable specification.

6.7. Surface Water Disposal

Soakaway testing in accordance with BRE365 was beyond the scope of this investigation, given the cohesive nature of the underlying geology it is unlikely soakaways would be feasible.

7. CONTAMINATION RISK ASSESSMENT

7.1. Results of the Preliminary Risk Assessment

The tabulated Conceptual Site Model (CSM) developed by the Ground and Water Desk Study (ref. GWPR7060/DS/July 2026) is reproduced in section 2.8. For the complete information please see the Desk Study report.

No additional source of contamination, pathway or receptor was identified between the desk study and the ground investigation and as such, it was not necessary to modify the CSM.

In the UK, the assessment of risk from contamination follows the source-pathway-receptor (SPR) approach. For a risk to be present there must be a source of contamination, a receptor or receptors, and a pathway for contaminants to migrate or be absorbed. If there is a linkage between any given source and receptor, then a quantitative risk assessment is used to assess the significance or impact of the pollutant linkage.

7.2. Sampling Locations

The synopsis for the trial hole locations and their final depth can be seen tabulated below. A trial hole location plan is provided within Figure 3. The table also indicates whether any locations targeted a source of contamination as well as the proposed end-use. The proposed development can be seen in Figure 2.

Trial Hole Location Synopsis (Visit 1)		
Trial Hole/Final Depth	Sampling Strategy	Proposed End-Use
BH1/20.70m	Stratified Random	Footprint of Proposed Building
BH2/34.20m	Stratified Random	Footprint of Proposed Building
BH3/30.10m	Stratified Random	Footprint of Proposed Building
BH4/35.00m	Stratified Random	Footprint of Proposed Building
BH5/20.80m	Stratified Random	Footprint of Proposed Building
TP1/1.00m	Stratified Random	Soft Landscaping
TP2/1.00m	Stratified Random	Soft Landscaping
TP3/1.00m	Stratified Random	Soft Landscaping
TP4/1.00m	Stratified Random	Soft Landscaping
TP5/1.00m	Stratified Random	Soft Landscaping
TP6/1.00m	Stratified Random	Soft Landscaping
TP7/1.00m	Stratified Random	Public Open Space
TP8/2.60m	Stratified Random	Public Open Space
TP9/1.50m	Stratified Random	Public Open Space
TP10/1.00m	Stratified Random	Public Open Space
TP11/1.00m	Stratified Random	Public Open Space
TP12/1.00m	Stratified Random	Public Open Space
TP13/1.00m	Stratified Random	Footprint of Proposed Building
TP14/1.50m	Stratified Random	Soft Landscaping
TP15/1.00m	Stratified Random	Footprint of Proposed Building
TP16/1.00m	Stratified Random	Soft Landscaping
TP17/1.00m	Stratified Random	Footprint of Proposed Building
TP18/1.00m	Stratified Random	Soft Landscaping
TP19/1.00m	Stratified Random	Soft Landscaping

Trial Hole Location Synopsis (Visit 2)		
Trial Hole/Final Depth	Sampling Strategy	Proposed End-Use
TP101/1.00m	Targeted to BGS location of Weald Clay Formation - Ironstone	Soft Landscaping
TP102/1.00m		Soft Landscaping
TP103/1.00m		Soft Landscaping
TP104/1.00m		Soft Landscaping
TP105/1.00m		Soft Landscaping
TP106/1.00m		Soft Landscaping
TP107/1.00m		Public Open Space
TP108/1.00m		Public Open Space
TP109/1.00m		Soft Landscaping
TP110/1.00m		Soft Landscaping

7.3. Soil Risk Assessment

Sampling depths were chosen to reflect the receptor of concern (e.g. human health, controlled waters and vegetation). The samples were scheduled under a stratified random strategy to get even coverage of the site. The receptors relevant to the sampling depths are tabulated below.

Summary of Receptors per Sample Depth	
Depth	Receptors
Shallow Samples (< 0.75m bgl)	• End Users (Residents/Future site visitors) • Construction workers during development • Site operatives during maintenance works • Neighbours and public • Vegetation within soft landscaped areas (shallow rooted) • Secondary A Aquifer (Alluvium and Horsham Stone Member) • Buried Concrete • Receiving landfill
Moderate Samples (0.75 – 1.50m bgl)	• Construction workers during development • Site operatives during maintenance works • Vegetation within soft landscaped areas (deep rooted) • Secondary A Aquifer (Alluvium and Horsham Stone Member) • Buried Concrete • Receiving landfill • Underground services (water pipes)
Deep Samples (> 1.50m bgl)	• Buried Concrete

Chemical laboratory testing, scheduled by Ground and Water Limited, and carried out by i2 Analytical Limited, was undertaken on ten samples of Made Ground, nine samples of Topsoil and seventeen samples of Weald Clay Formation. The samples were subjected to a combination of analysis that comprised:

- Asbestos screen;
- Semi-metals and heavy metals incl. Arsenic, Cadmium, Chromium (incl. Hexavalent Chromium), Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc;
- Polycyclic Aromatic Hydrocarbons (PAH's) incl. Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene,

- Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene;
- Speciated TPH including full aliphatic/aromatic split;
- BTEX compounds (Benzene, Toluene, Ethylbenzene, Xylene) and MTBE – used as marker compounds for Volatile Organic Compounds (VOCs).

A breakdown of the number of tests undertaken for each determinand is discussed in further sections. The chemical laboratory results are presented in Appendix E.

7.3.1. Soil Assessment Criteria and Results

At the time of reporting, August 2026, the proposed development was understood to comprise the construction of up to 270 residential dwellings and extra care units; commercial floorspace; the community building, the neighbourhood square, cycle and pedestrian connections, parking and associated infrastructure. The north-east will also comprise open space, multi-use games areas (MUGA), public art, green circle cycle link and associated infrastructure. The proposed illustrative masterplan can be seen within Figure 2.

Based on the proposed development, the results of the chemical laboratory testing were compared to the Generic Assessment Criteria (GAC) for a **'Residential with homegrown produce'** land-use scenario, as this was considered the most appropriate land-use scenario.

Where a contaminant of concern's GAC varies according to the Soil's Organic Matter (SOM), the SOM recorded for each uncontaminated soil type was used to derive the appropriate GAC for each soil type. A SOM value of 1%, the most conservative value, was utilised.

A summary of the analytical results and the comparison to the determinands adopted screening value are presented in the table below and overleaf.

Soil Contamination Test Results and Screening Values					
Determinand	Number of Samples	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Adopted Screening Value (mg/kg)	Was the adopted screening value exceeded for relevant land-use scenario?
INORGANICS					
Asbestos	21	ND	ND	ND	No
Cyanide (total)	21	< 1	< 1	24	No
Phenols	21	< 1	< 1	280	No
METALS					
Arsenic	36	3.5	240	37	Yes – TP4/0.50
Boron	21	0.2	0.4	290	No
Cadmium	21	<0.2	0.6	11	No
Chromium (III)	21	20	37	910	No
Chromium (Hexavalent)	21	< 1.8	< 1.8	6	No
Copper	21	16	50	2,400	No
Lead	21	16	71	200	No
Mercury	21	< 0.3	< 0.3	1.2	No
Nickel	21	11	41	130	No
Selenium	21	< 1	3.1	250	No
Vanadium	21	30	72	410	No
Zinc	21	46	120	3,700	No

TOTAL PETROLEUM HYDROCARBONS (TPHs)					
Aliphatic >C5 - C6	10	< 0.010	< 0.010	42	No
Aliphatic >C6 - C8	10	< 0.010	< 0.010	100	No
Aliphatic >C8 - C10	10	< 0.010	< 0.010	27	No
Aliphatic >C10 - C12	10	< 1.0	< 1.0	130	No
Aliphatic >C12 - C16	10	< 2.0	< 2.0	1,100	No
Aliphatic >C16 - C21	10	< 8.0	< 8.0	65,000	No
Aliphatic >C21 - C35	10	< 8.0	16		
Aliphatic >C35 – C40	10	< 10	< 10	65,000	No
Aromatic >C5 - C7	10	< 0.010	< 0.010	70	No
Aromatic >C7 - C8	10	< 0.010	< 0.010	130	No
Aromatic >C8 - C10	10	< 0.020	< 0.020	34	No
Aromatic >C10 - C12	10	< 1.0	< 1.0	74	No
Aromatic >C12 - C16	10	< 2.0	< 2.0	140	No
Aromatic >C16 - C21	10	< 10	11	260	No
Aromatic >C21 - C35	10	< 10	30	1,100	No
Aromatic >C35 – C40	10	< 10	10	1100	No
Benzene	10	< 0.002	< 0.002	0.087	No
Toluene	10	< 0.005	< 0.005	130	No
Ethylbenzene	10	< 0.002	< 0.002	47	No
m,p-Xylene	10	< 0.002	< 0.002	56	No
o-Xylene	10	< 0.002	< 0.002	60	No
POLYCYCLIC-AROMATIC HYDROCARBONS					
Acenaphthene	21	< 0.05	0.12	210	No
Acenaphthylene	21	< 0.05	0.08	170	No
Anthracene	21	< 0.05	0.37	2,400	No
Benzo(a)anthracene	21	< 0.05	3.3	7.2	No
Benzo(a)pyrene	21	< 0.05	0.86	2.2	No
Benzo(b)fluoranthene	21	< 0.05	1.8	2.6	No
Benzo(ghi)perylene	21	< 0.05	0.21	320	No
Benzo(k)fluoranthene	21	< 0.05	2.2	77	No
Chrysene	21	< 0.05	1.6	15	No
Dibenzo(a,h)anthracene	21	< 0.05	0.99	0.24	No
Fluoranthene	21	< 0.05	3.7	280	No
Fluorene	21	< 0.05	0.09	170	No
Indeno(1,2,3-cd)pyrene	21	< 0.05	2	27	No
Naphthalene	21	< 0.05	< 0.05	2.3	No
Phenanthrene	21	< 0.05	1.6	95	No
Pyrene	21	< 0.05	3.3	620	No
MARKER FOR VOLATILE ORGANIC COMPOUND					
Methyl tert-butyl ether (MTBE)	10	< 0.005	< 0.005	49	No
The derivation of the Soil Assessment Criteria used within this report can be seen within Appendix F. The soil concentrations were typically compared to the LQM/CIEH Suitable for Use Levels (S4UL) (2014), based upon the assumption of 1% soil organic matter. A screening value for Lead is based on the Category 4 Screening Levels (C4SLs). Where no S4UL or C4SL is available for Cyanide, a SoBRA acute GAC is assigned. Where no S4UL or C4SL is available for MTBE, a CL:AIRE 2010 GAC is assigned. Where exceedances are noted, the trial hole and depth of sample is recorded.					

The proposed development includes areas of soft-landscaping, where shallow rooted vegetation may be exposed to aggressive ground conditions. The previous table compares the results of the laboratory

analysis to GAC that is protective of Human Health and therefore different GAC is required for vegetation.

Soil Contamination Test Results and Screening Value					
Determinand	Number of Samples	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Adopted Screening Value (mg/kg)	Was the adopted screening value exceeded for relevant land-use scenario?
Copper	21	16	50	100	No
Nickel	21	11	41	60	No
Zinc	21	46	120	200	No
The derivation of the Soil Assessment Criteria used within this report can be seen within Appendix F. The soil concentrations were compared to BS3882:2015 <i>Specification for Topsoil</i> and based on differing pH. For the purpose of conservatism, the pH of the soils have been assumed to be below 6 within this table. Where exceedances are noted, the trial hole and depth of sample is recorded.					

7.3.2. Soil Assessment

The comparison between the laboratory analysis and the assessment criteria indicates that there is a localised unacceptable risk to future receptors caused by an exceedance of arsenic in TP4/0.50m bgl. The remaining determinands were identified at below the adopted screening value and are not considered to represent an unacceptable risk to future receptors. Where an unacceptable risk to future receptors remains, mitigation is required.

It is considered likely that the exceedance relates to the ironstone noted within the natural Weald Clay Formation sample. Seventeen further samples of the Weald Clay Formation located along or in close proximity to where the BGS show the ironstone band were undertaken during the second visit. Only one of these samples contained traces of ironstone and all were below the relevant assessment criteria.

Due to the nature of the contamination encountered at the site, it is considered that there is an unacceptable risk to future receptors at this stage, remedial options will be outlined in Section 8.

Asbestos

No asbestos has been identified during the testing, however, an **Asbestos Management Strategy** should be put in place so that any potentially asbestos containing materials are identified and removed from site in a suitable manner to prevent cross-contamination.

7.3.2.1. Water Supply Pipe Risk Assessment

As part of the proposed development it is expected that new water supply pipes will be installed at the site. Water supply pipes have the potential to be exposed to contaminants in the ground that can lead to unacceptable concentrations within the drinking water. If a risk is identified, specialist pipes that are protective of the drinking water are required.

A pipe selection risk assessment should be submitted to the water supply company as part of the development based on the supplier's assessment criteria. An indication of whether there is likely to be a risk can be seen tabulated below, where the PE pipe thresholds are based on *UKWIR Contaminated Land Assessment Guidance, 2014*.

Pipe Selection Risk Assessment			
Determinand	PE Pipe Threshold (mg/kg)	Laboratory Analysis Range (mg/kg)	Was the Threshold Exceeded?
Total BTEX and MTBE	0.1	LOD	No
Total VOCs	0.5	LOD	No
Total SVOCs	2	LOD	No
Phenols	2	LOD	No
TPH EC5 – EC10 (aliphatics and aromatics)	2	LOD	No
TPH EC10 – EC16 (aliphatics and aromatics)	10	LOD	No
TPH EC16 – EC40 (aliphatics and aromatics)	500	LOD - < 85	No
Naphthalene	5	LOD	No

The results indicate that no determinands were above the threshold for the use of a PE pipe at the site.

7.4. Groundwater Risk Assessment

In the UK, the water environment is protected under a number of regulatory regimes, mainly governed by the Environment Agency. The Environment Agency is consulted when there may be a risk to Controlled Waters, or where a pollution incident has occurred historically. The Water Framework Directive is implemented in various guises covering groundwater, surface water and drinking water supply.

The soil samples analysed as part of the risk assessments in section 7.3 have been used to undertake a controlled waters risk assessment. At this stage, the conceptual site model and the determinand concentrations of the soils are used to indicate whether the concentrations are sufficient to impact the receptor. At this stage, dilution, dispersion and attenuation along the pathway are not considered.

A study of the aquifer maps on the DEFRA website revealed the site was underlain by a Secondary A Aquifer comprising the superficial Alluvium in the east, underlain by a Secondary A Aquifer comprising the bedrock Horsham Stone Member and Unproductive Strata comprising bedrock Weald Clay Formation.

Examination of the Environment Agency records showed that the site did not fall within a Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water feature was Holmbush Gill which was flowing in a southerly direction and was located adjacent to the southern and eastern boundary and intersecting the site in the north-eastern corner.

From analysis of hydrogeological and topographical maps the actual groundwater table was anticipated to be encountered at depth below the Weald Clay Formation. Some amounts of perched water however may be present at shallower depths within Made Ground, parts of the Alluvium or in the siltstone/sandstone of the Weald Clay Formation/Horsham Stone Member. It was considered that groundwater was flowing in a south/south-easterly direction toward the stream and in line with local topography.

During the site investigation, Made Ground was encountered to a maximum depth of 1.00m bgl, locally overlying Alluvium but generally overlying weathered Weald Clay Formation comprising silty

clays and clayey silts grading to mudstone, siltstone and sandstone. A groundwater strike was encountered at 10.50m bgl in BH5. No other locations recorded groundwater strikes during the intrusive investigation.

The only high concentrations of contaminants of concern was a result of high arsenic within the natural in one location relating to the ironstone content. As this is a result of a localised seam of ironstone, and is naturally sourced it is not considered anything is required in order to protect controlled waters. Similarly, with respect to human health given the depth of any groundwater (>10m bgl) it is unlikely any pathway would be created to human health receptors. No further action is considered necessary.

The findings of this risk assessment should be agreed with the Environment Agency.

7.5. Ground Gas Risk Assessment

A review of freely available information prior to site works, including historical mapping and landfill registers / Phase I desk study, only identified localised Alluvium as a source of ground-gas. Given the localised location of the Alluvium (TP11, BH4) and the thickness (0.35m) it is not considered this would pose a risk to the majority of the site. BH4 is the only location where a building is proposed and Alluvium has been identified, as part of foundation excavations as the Alluvium does not extend further than 0.60m bgl a significant portion will be removed to accommodate the foundations therefore removing the risk. It should also be noted that Made Ground was recorded no deeper than 1.00m bgl and was not widespread, therefore Made Ground also does not pose a ground-gas risk at the site. Therefore, no further ground-gas risk assessment is required.

7.6. Vapour Risk Assessment

The CSM did not identify a significant source of contamination that may pose an unacceptable risk to receptors through vapours.

7.6.1. Soil Assessment

In order to assess the potential for a vapour risk at the site, soil samples were sent to the laboratory for analysis (Appendix E). The testing suites included contaminants that may be present in the vapour phase (Mercury, Naphthalene, TPHs, BTEX Compounds and MTBE) taken within Made Ground, Topsoil and natural samples.

All samples scheduled (10 - 21No.) identified determinands at concentrations lower than the laboratory limit of detection or below their relevant assessment criteria.

Therefore, not further risk assessment is required with respect to vapours.

7.7. Updated Conceptual Site Model

Following completion of the Phase 2 Site Investigation, the CSM, inclusive of associated risk, within Section 2.8 of this report was re-evaluated.

For ease of reference and understanding, the risks have been re-assigned within this risk assessment against three possible levels / categories, summarised in the table below.

Risk Categories used in the Tabulated CSM

Low Risk	Regarding this potential SPR linkage, the site is considered suitable for the proposed end-use and there is not considered to be an unacceptable risk to receptors.
Moderate Risk	Regarding this potential SPR linkage, the site is suitable for the proposed end-use however remediation and/or further investigation is required.
High Risk	Regarding this potential SPR linkage, the site is not suitable for proposed end-use and there is an unacceptable risk to receptors. Urgent action required in the short term.

Tabulated Conceptual Site Model – Pollutant Linkage Summary				(On-Site Sources)
Potential Sources	Potential Absorption Pathways	Potential Receptors	Risk Classification	
Made Ground from site compound in NW and ground workings in NE: - Asbestos, - PAHs, - TPHs, - VOCs, - Sulphates, and - Metals, particularly arsenic where ironstone band is.	- Direct ingestion of soil and soil derived dust - Dermal contact of soil and soil derived dust - Inhalation of dust (indoors and outdoors) with elevated concentration of determinands - Ingestion of home-grown produce, and soils attached - Direct ingestion of groundwater - Inhalation of volatile vapour (indoors and outdoors)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development - Site operatives during maintenance works - Neighbours and public	Moderate – arsenic within natural in TP4 remediation required	
	- Direct uptake of groundwater - Direct uptake of determinands in the soil			
	- Anthropogenic (man-made) pathways - Vertical and lateral migration in permeable strata - Surface water runoff			
	Direct contact with aggressive ground conditions			
	Aggressive ground conditions with Made Ground and natural ground, including groundwater: Sulphates.			
Aggressive ground conditions with Made Ground and natural ground, including groundwater: PAH/TPH.	Direct contact with aggressive ground conditions	Building Materials and Services Underground services (water pipes)	Low	
Ground gases generated by Alluvium Deposits: - Methane, - Carbon Dioxide, - Hydrogen Sulphide, and - Carbon Monoxide.	Human Health - End Users (Residents/Future site visitors) - Construction workers during development (especially in confined spaces) - Site operatives during maintenance works in confined spaces - Neighbours and public			Low

	• Migration through anthropogenic & natural pathways Explosion (methane only)	• Buildings • Confined spaces • Underground services	Low
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8. CONTAMINATION RECOMMENDATIONS AND REMEDIATION STRATEGY

Based on the results of the intrusive works, chemical analyses and risk assessments undertaken, the following has been identified that requires further action:

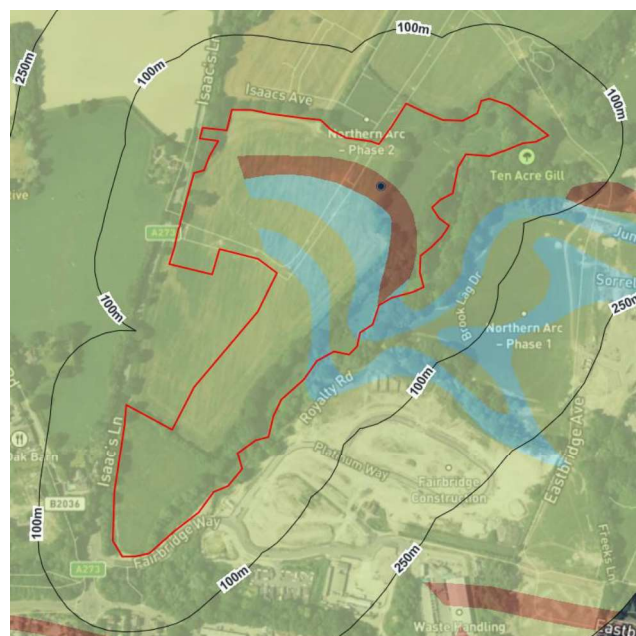
- One contaminant (arsenic) has been found at an unacceptable concentration within the natural ground that requires further investigation.

An Asbestos Management Strategy should be put in place so that any potentially asbestos containing materials are identified and removed from site in a suitable manner to prevent cross-contamination.

8.1. Soils

8.1.1. Remediation

At this stage the risk assessment suggests the arsenic is originating from ironstone within the natural Weald Clay Formation. The red band shown on the diagram below shows the location of the ironstone taken from BGS records.



Seventeen further samples of the Weald Clay Formation located along or in close proximity to where the BGS show the ironstone band were undertaken during the second visit. Only one of these samples contained traces of ironstone and all were below the relevant assessment criteria. Therefore, it is only TP4/0.50m bgl that has arsenic levels of concern.

A Watching Brief is recommended and formation level testing for arsenic for any garden plots or soft landscaping areas within the hotspot area shown on Figure 4 around TP4/0.50m or any locations that are in or within the vicinity of the ironstone band shown above. This will comprise the following steps:

- Watching brief: ironstone identified at formation level?
 - Yes – arsenic testing and subsequent 600mm capping system for private gardens and 450mm for soft landscaped areas if >37mg/kg
 - No – minimum 150mm Topsoil for growing medium

The private gardens must have a capping system comprising the following:

- A 600mm clean capping of soils;
- Validation of the clean capping system by a suitably trained Ground and Water Limited engineer.

The soft landscaped areas must have a capping system comprising the following:

- A 450mm clean capping of soils;
- Validation of the clean capping system by a suitably trained Ground and Water Limited engineer.

All other areas:

- A minimum of 150mm Topsoil to act as a growing medium.

Full liaison must be made with the statutory authority, prior to the implementation of this remediation strategy and/or removal of soils from the site. All works must be undertaken to meet their approval.

8.1.1.1. 450/600mm Clean Capping of Soil

The capping system should be at least 450/600mm in thickness within all garden areas and soft landscaping. It is recommended that at least the top 150mm of the clean capping should comprise suitable topsoil for use as a growing medium.

All subsoil and topsoil must be fit for purpose to ensure that the receptors cannot come into contact with determinands that could be detrimental to their health. See 'Imported Material' Section 8.3. It has been assumed that for the principal contaminant of concern (arsenic) a maximum concentration of 37 mg/kg will be present within the capping of soil.

The thickness of the capping system has been calculated based on a mixing zone of 600mm, assuming that they will not be implemented on a slope with a gradient in excess of 1 in 12 and are away from the influence of burrowing animals, such as rabbits and badgers.

8.1.1.2. Change in Level

In locations where site levels are to be lowered, Made Ground should be removed from the location to allow the capping of 450/600mm to be placed. Materials should be removed and stockpiled on an impermeable liner with raised edges and covered at all times. This contamination stockpile destined for removal from site should be stored away from imported soils to avoid cross-contamination. The void should then be backfilled with 600mm of clean certified soil.

Materials to be removed off-site must be classified by carrying out Waste Acceptance Criteria (WAC) testing. A registered contractor must undertake the removal of waste. Consignment notes for the removal of waste must be obtained and kept for inclusion within the final validation Report.

If levels are raised, the imported materials should be clean and validated, where the top 600mm within areas of soft landscaping will still need to be covered with a clean capping of soil.

8.1.1.3. Validation

The remediation works outlined above will need to be inspected and independently validated by a Ground and Water Limited Engineer. All excavations will need to be inspected, documented and photographed. Validation holes should prove the depth of the clean cover and enable the sampling of soils. Due to the design of the proposed development, validation should be undertaken at a rate of 1 validation trial hole and 1 sample of clean cover per plot.

8.1.2. Water Supply Pipes

The Water Supply pipe risk assessment indicated that the use of PE pipes is appropriate at the site and no further measures are required.

8.2. Groundwater, Ground Gas and Vapours

The groundwater, ground-gas and vapour risk assessment did not require any further investigation at this stage.

8.3. Imported Material

It is required that clean soils will be brought onto site as part of the remediation works. Any soil which is to be imported onto the site must undergo chemical analysis to prove that it is suitable for the purpose for which it is intended.

The soil must be fit for purpose and must either be supplied with traceable chemical laboratory test certificates or be tested, prior to placing (ideally) and after placing, to ensure that the future receptors (human health and vegetation) cannot come into contact with compounds that could be detrimental to their health. The compounds that are to be tested for are those given in the Generic Assessment Criteria, which can be viewed in Appendix F of this report.

8.4. Waste Disposal

The excavation of foundations and other soils is likely to produce waste which will require classification and then recycling or removal from site.

Under the Landfill (England and Wales) Regulations 2002 (as amended), prior to disposal, all waste must be classified as either: Inert; Non-hazardous; or Hazardous.

The Environment Agency's Hazardous Waste Technical Guidance (WM3) document outlines the methodology for classifying wastes. Once classified the waste can be removed to the appropriately licensed facilities, with some waste requiring pre-treatments prior to disposal.

Following the investigation, 21No. samples (ten samples of Made Ground, nine samples of Topsoil and two samples of Weald Clay Formation) were submitted to the analytical laboratory to undergo a suite of testing for contamination testing, as discussed in the previous sections. Sampling depths were chosen to reflect the receptor of concern, human health, and typically comprised a surface or near surface sample and periodically to 1.00m bgl. Any horizon where olfactory or visual evidence of contamination was present was also sampled.

Based on a risk phase analysis of the chemical laboratory test results, in accordance with EC Hazardous Waste Directive and undertaken by Ground and Water Limited, all soil samples of Made Ground

encountered on-site were NON-HAZARDOUS. The results of the assessment are given within Appendix G.

It is important to note that whilst we consider our in-house assessment tool to be an accurate interpretation of the requirements of WM3, therefore producing an initial classification in accordance with the guidance, this method classifies soils as either non-hazardous or hazardous and landfill operators have their own assessment tools and can often come to different conclusions. As a result, some landfill operators could refuse to take apparently suitable waste. It is recommended that the receiving landfill views the results of this assessment and the chemical laboratory results to determine their own classification.

In addition to the samples described above, 3No. samples of Made Ground (TP1/0.20, TP8/0.20 TP11/0.20), 2No. of Topsoil (TP6/0.50, TP18/0.20) and 1No. of natural soils (BH5/0.20) were scheduled to undergo Waste Acceptance Criteria (WAC) testing with single batch leachate. The results indicate that all samples conformed to the Inert Waste Classification.

It should be noted that the receiving landfill may see the presence of Made Ground within the soils to be indicative of a non-hazardous classification despite the presence of the WAC testing certificates indicating that it is inert. Therefore, it should be considered that all Made Ground is classified as Non-hazardous, subject to finalising with the receiving landfill.

Where contaminated soils are to be removed, they should be placed on an impermeable membrane (visqueen or similar) to ensure that no cross-contamination of soils occurs.

8.5. Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust would be generated as a result of construction activities.

The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.

FIGURES

APPENDIX A: Conditions and Limitations

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The report has been prepared on the basis of information, data and materials which were available at the time of writing. Accordingly, any conclusions, opinions or judgements made in the report should not be regarded as definitive or relied upon to the exclusion of other information, opinions and judgements.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief; as such these do not necessarily address all aspects of ground behaviour at the site. No liability is accepted for any reliance placed on it by others unless specifically agreed in writing.

Any decisions made by you, or by any organisation, agency or person who has read, received or been provided with information contained in the report ("you" or "the Recipient") are decisions of the Recipient and we will not make, or be deemed to make, any decisions on behalf of any Recipient. We will not be liable for the consequences of any such decisions.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Any Recipient must take into account any other factors apart from the Report of which they and their experts and advisers are or should be aware. The information, data, conclusions, opinions and judgements set out in the report may relate to certain contexts and may not be suitable in other contexts. It is your responsibility to ensure that you do not use the information we provide in the wrong context.

This report is based on readily available geological records, the recorded physical investigation, the strata observed in the works, together with the results of completed site and laboratory tests. Whilst skill and care has been taken to interpret these conditions likely between or below investigation points, the possibility of other characteristics not revealed cannot be discounted, for which no liability can be accepted. The impact of our assessment on other aspects of the development required evaluation by other involved parties.

The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous in ground activities. The ground conditions have been sampled or monitored in recorded locations and tests for some of the more common chemicals generally expected. Other concentrations of types of chemicals may exist.

The conclusions and recommendations relate to Phase 1c Northern Arc, Isaac's Lane, Burgess Hill, West Sussex RH15 8RA.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sampler borehole implies the specific technique used to produce a trial hole.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets, remain with Ground and Water Limited. Licence is for the sole use of the client and may not be assigned, transferred or given to a third party.

Only our client may rely on this report and should this report or any information contained in it be provided to any third party we accept no responsibility to the third party for the contents of this report save to the extent expressly outlined by us in writing in a reliance letter addressed from us to the third party.

Recipients are not permitted to publish this report outside of their organisation without our express written consent.

APPENDIX B:

Technical Glossary

APPENDIX C: Trial Hole Logs

APPENDIX D: Geotechnical Laboratory Testing

APPENDIX E:

Chemical Laboratory Testing

APPENDIX F:

Soil

Assessment

Criteria

APPENDIX G: Waste Hazard Assessment

geotechnical and environmental consultants



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