

Imberhorne Farm

Ground Investigation Report

Date:

26 August 2026

Prepared for:

Rangeford Villages

Prepared by:

Tom Creighton

Project/File:

333701756-STN-XX-XX-RP-GE-0001



Document control sheet

Issued by	Stantec UK Limited Great Suffolk Yard 127-131 Great Suffolk Street London SE1 1PP UNITED KINGDOM stantec.com	+44(0) 203 8468456 stantec.com
Client	Rangeford Villages	
Project name	Imberhorne Farm	
Title	Ground Investigation Report	
Doc ref	333701756-STN-XX-XX-RP-GE-0001	
Project number	333701756	
Status	Draft	
Date	26 August 2026	

Document production record

Issue number	P02	Name
Prepared by	Emily Cork BSc (Hons) MSc EngTech(ICE)	
Checked by	Helen Gardiner MSci CEnv MIScEnv	
Approved by	Kat Barker MSci CGeol RoGEP	

Document revision record

Issue number	Status	Date	Revision details
P01	Draft	20/08/2026	Draft
P02	S2	26/08/2026	Updated to address clients comments

Stantec UK Limited has prepared this report in accordance with the instructions of the above-named client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.



Table of Contents

Document control sheet	i
Executive Summary	ii
1 Introduction	1
1.1 Terms of reference	1
1.2 Objectives	1
1.3 Scope	1
1.4 Available information	2
1.5 Regulatory context and guidance	2
2 Site Setting	4
2.1 Site referencing	4
2.2 Site Description	5
2.3 Published Geology	6
2.4 Hydrology and Hydrogeology	7
3 Summary of previous reports	8
3.1 Harrison Group Environmental Limited, September 2021. 'Ground Investigation Factual Report – Imberhorne Farm, East Grinstead. Ref: GL24233.	8
3.2 Campbell Reith, June 2022. 'Imberhorne Farm, East Grinstead - Geoenvironmental & Geotechnical Desktop Study'. Ref. 13694-CRH-XX-XX-RP-LQ-7501_DTS-P01.....	9
3.3 Omnia. January 2023. 'Phase II Factual Ground Investigation Report – Proposed Care Village – Imberhorne Farm, East Grinstead, RH19 1TX, Ref: A11898/2.0	9
3.4 Omnia. January 2023. 'Phase II Additional Geo-Environmental Site Assessment, Proposed Care Village – Imberhorne Farm, East Grinstead, RH19 1TX. Ref: A11898/3.0.....	10
4 Preliminary Ground Model	12
5 Ground hazards	14
5.1 Preliminary geotechnical hazard identification	14
5.2 Potential development elements affected	15
6 Initial Conceptual Site Model and Preliminary Risk Assessment	16
6.1 Introduction	16
6.2 Potential contaminants	16
6.3 Potential on-site sources of contamination	16
6.4 Potential off-site sources of contamination	16
6.5 Potential receptors	16
6.6 Potential pathways	17
6.7 Summary of potential contaminant linkages	17
7 Ground investigations	18
7.1 Site works	18
7.2 Geo-environmental testing	20
7.2.1 Sampling strategy and protocols	20
7.2.2 Site screening tests	20
7.2.3 Geo-environmental monitoring	20
7.2.4 Geo-environmental laboratory analyses	20
7.3 Geotechnical testing	23
7.3.1 In-situ geotechnical monitoring	23
7.3.2 Geotechnical laboratory testing	23
8 Ground investigation records and data	24
8.1 Physical ground conditions	24
8.1.1 Summary of strata encountered	24
8.1.2 Topsoil	24
8.1.3 Made Ground	25



Ground Investigation Report

Table of Contents

8.1.4	Upper Tunbridge Wells Sand	25
8.1.5	Grinstead Clay Member	25
8.2	Visual and olfactory indicators of contamination (soil)	26
8.3	Soil Organic Carbon Content	26
8.4	Groundwater	27
8.4.1	Groundwater observations and levels	27
8.4.2	Infiltration tests	28
8.4.3	Groundwater summary	28
8.5	Ground gases (carbon dioxide and methane)	29
8.6	Organic vapours	29
8.7	Updated ground model	29
9	Geotechnical data	31
9.1	Introduction	31
9.2	Water Content	31
9.3	Plasticity	32
9.4	Particle size distribution	33
9.5	In-situ SPT data	34
9.6	Sulphate content	36
9.7	Derived values of ground properties	37
10	Geotechnical assessment	39
10.1	Geotechnical categorisation of the proposed development	39
10.2	Groundwork	39
10.2.1	Site preparation	39
10.2.2	Groundworks	39
10.2.3	Earthworks/reuse of site-won materials	40
10.2.4	Settlement	41
10.3	Foundation recommendations	41
10.3.1	Site Zoning	42
10.3.2	Ground Improvement	42
10.3.3	Shallow Foundations	43
10.3.4	Piled Foundations	43
10.3.5	Foundation works risk assessment	44
10.3.6	Working platform	44
10.4	Roads and pavements	44
10.5	Drainage	45
10.6	Buried concrete	45
11	Geo-environmental assessment	46
11.1	Objectives	46
11.2	Updated conceptual site model	46
11.3	Risk assessment approach	47
11.4	Data Sets	47
11.5	Human health risk assessment	47
11.5.1	Generic Assessment Criteria	47
11.5.2	Assessment results	48
11.5.3	Risk evaluation	48
11.6	Controlled Waters Risk Assessment	49
11.6.1	Generic Assessment Criteria	49
11.6.2	Assessment results	50
11.6.3	Risk evaluation	50
11.7	Ground gas risk assessment	51
11.7.1	Assessment Criteria	51
11.7.2	Data adequacy	52
11.7.3	Assessment results	52
11.7.4	Risk evaluation	52
11.8	Phytotoxicity risk assessment	52



Ground Investigation Report

Table of Contents

11.8.1	Water Pipelines	53
11.8.2	Other construction materials	53
11.9	Contamination risk to construction workers	54
11.9.1	Metals, metalloids, PAH and petroleum hydrocarbons	54
11.9.2	Ground gas	54
11.9.3	Vapours	54
11.9.4	Asbestos	54
11.10	Consideration of Climate Change	55
11.11	Updated Conceptual Site Model	56
11.12	Preliminary mitigation measures	57
11.12.1	Summary	57
11.12.2	Enablement phase	58
11.12.3	Construction phase	59
12	Waste and materials management	60
12.1	Introduction	60
12.2	Waste disposal	60
12.2.1	Principles	60
12.2.2	HazWasteOnline™ assessment	61
12.2.3	WAC testing	61
12.2.4	Preliminary waste disposal options	61
12.2.5	General waste comments	61
12.3	Materials management	62
12.3.1	Introduction	62
13	Uncertainties and limitations	66
13.1	Site-specific comments	66
13.2	General comments	66
14	Recommendations for further work	68
15	References	69
List of Tables		
Table 2-1: Site referencing information		4
Table 2-2: Site description		5
Table 2-3: Published Geological Sequence		6
Table 2-4: Aquifer system		7
Table 4-1: Preliminary Ground Model		12
Table 5-1: Preliminary geotechnical hazard identification		14
Table 6-1: Initial CSM		17
Table 7-1: Summary of site works		18
Table 7-2: Summary of monitoring installations (historical and Stantec 2026)		19
Table 7-3: Geo-environmental analyses of soils or other solids from Stantec 2026 ground investigation		20
Table 7-4: Geo-environmental analyses of soils or other solids from Omnia 2022 ground investigation		21
Table 7-5: Geo-environmental analyses of waters, leachates or other liquids from Stantec 2026 ground investigation		21
Table 7-6: Geo-environmental analyses of waters, leachates or other liquids from Omnia 2022 ground investigation		22
Table 7-7: Summary of sample numbers for geotechnical tests		23
Table 8-1: Strata encountered		24
Table 8-2: Visual and olfactory indicators of contamination - soils		26
Table 8-3: Soil organic carbon content		26
Table 8-4: Groundwater encountered during site works		27
Table 8-5: Monitoring well response zones		27
Table 8-6: Groundwater level data summary		28
Table 8-7: Range of ground gas data		29
Table 9-1: Water Content		31
Table 9-2: Volume change potential		32



Ground Investigation Report

Table of Contents

Table 9-3: PSD results summary	34
Table 9-4: Soil strength results and derived values.....	34
Table 9-5: Aggressive chemical environment concrete testing results.....	37
Table 9-6: Worst case design sulphate and aggressive chemical environment for concrete classification	37
Table 9-7: Characteristic geotechnical values.....	38
Table 11-1: Characteristic Situation as per BS8485:2015+A1:2019	51
Table 11-2: Updated plausible contaminant linkages.....	56

List of Figures

Figure 2-1: Site location	4
Figure 2-2: Aerial image.....	5
Figure 2-3: Recorded extent of the landfill	6
Figure 9-1: Plasticity versus liquid limit (Stantec 2026 data).....	33
Figure 9-2: SPT N ₆₀ versus depth	36
Figure 11-1: Illustrative Conceptual Site Model.....	57

List of Appendices

Appendix A Drawings

Appendix B Exploratory hole location plan, exploratory hole logs and photographs

- B.1 Exploratory hole location plan
- B.2 Exploratory hole logs
- B.3 Exploratory hole photographs

Appendix C Site monitoring data

- C.1 Site monitoring data
- C.2 Ground gas risk classification

Appendix D Geotechnical test results and geotechnical plots

- D.1 Geotechnical laboratory test results
- D.2 Geotechnical plots

Appendix E Contamination test results

- E.1 Contamination test results
- E.2 GAC derivation
- E.3 Human health GAC screening results
- E.4 Phytotoxic GAC screening results
- E.5 Controlled waters GAC screening results

Appendix F Waste classification

- F.1 HazWasteOnline™ assessment

Appendix G Preliminary geotechnical risk register

Appendix H Plausible source-pathway-receptor contaminant linkages

Appendix I Climate change considerations for CSM



Executive Summary

Site Information and setting	
Objectives	The works have been commissioned to support the planning application, to assist with clearing anticipated planning conditions and to assist with the design of the development.
Client	Rangeford Villages
Site name and location	Imberhorne Farm, East Grinstead, RH19 1TX.
Proposed development	The site development proposals are understood to comprise the development of a care village, as well as areas for attenuation.
Site Description	The site comprises a large grass covered field with areas of overgrown vegetation. A broken timber post-and-wire fence extends north-south across the western part of the site, with scattered bushes present along the line of the damaged fence. The site is bound by trees along the northern, southern, and western boundaries. The eastern boundary comprises an access road off Imberhorne Lane, with additional tree coverage towards the south-east. At the time of the investigation, the site perimeter was enclosed by Heras fencing and an ecological plastic barrier. Residential properties are located to the east and west of the site, with agricultural land to the north and south. Several commercial premises are also present to the west.
Desk study information	
Topography	The site slopes overall from east to west, with elevations reducing from approximately 123m AOD in the east to 112m OAD in the west. The northwestern and southwestern corners lie at around 114m AOD and exhibit a gentle fall towards the centre of the site.
Hydrology	Ponds are located adjacently west of the site.
Site history	The site comprises an undeveloped agricultural field underlain by a historical Made Ground, with Made Ground present across much of the Care Village footprint.
Geology	The geology at the site consists of Upper Tunbridge Wells Sand in the north and the Grinstead Clay Member in the south. The natural geology is overlain by Made Ground.
Natural geological hazards	There may be loose sand within the Upper Tunbridge Wells Sand and within the Made Ground.
Anthropomorphic geotechnical hazards	Made Ground is likely to be present as a result of historical tipping/filling.
Hydrogeology	The Upper Tunbridge Sands are classified as a Secondary A aquifer. The Grinstead Clay Member is classified as unproductive stratum. Groundwater is expected to flow to the west. The site is not located within a Source Protection Zone.
Preliminary conceptual site model based on desk study	
Potential contaminant sources	Made Ground possibly containing elevated concentrations of petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), metals, metalloids, asbestos, and Asbestos Containing Materials (ACMs) (S01). Organic materials in the Made Ground materials producing ground gases (carbon dioxide and methane) and vapours (S02).



Ground Investigation Report

Executive Summary

Potential contaminant linkages (for receptors for which there is or will be a pathway)	Humans (residential with/without plant uptake) Controlled waters – surface water / groundwater Plants Ecology Buildings / property
---	--

Ground model proven by investigation

Ground and groundwater conditions encountered by investigation	The ground conditions as proven by the investigation (s) undertaken at the site comprise: • Topsoil – to depths of between 0.20m and 0.50m bgl; over • Made Ground – to depths of between 0.50m and 3.50m bgl, comprising a mixture of domestic refuse, commercial and industrial waste and demolition waste, including plastic, metal, paper, wire, pipes, glass bottles, clothing, partially decomposed wood, animal bones and ash; over • Upper Tunbridge Wells Sand (in the north) – the base of this stratum was not proven. Comprised firm to stiff grey mottled orangish brown and yellowish brown sandy slightly gravelly CLAY, and medium dense brown gravelly clayey fine to coarse SAND; over • Grinstead Clay Member (in the south) - the base of this stratum was not proven. Comprised stiff brown mottled red slightly sandy CLAY, very stiff dark grey slightly sandy CLAY, firm orangish brown mottled grey slightly sandy slightly gravelly CLAY with iron-stained sandstone and mudstone Water levels recorded post-fieldwork ranged from 109.96m OD to 118.59mOD. groundwater flow is to the west. There is perched water within the Made Ground. Groundwater rests within the Grinstead Clay. There are visual and olfactory indicators in the form of string hydrocarbon odour and clack staining.
---	--

Summary of geotechnical conclusions

Groundwork	Excavation to proposed founding depth generally should be readily achievable with standard excavation plant. Excavations during investigation were generally stable, although slight spalling should be expected from the Made Ground and within the sands and gravels below the water table. The Grinstead Clay Member was noted to be fissured and whilst instability due to fissuring was not noted in the short trial pit excavations, fissuring can cause instability of longer excavations Water seepages into excavations are likely to be adequately controlled by sump pumping.
Foundations	On the basis of the ground conditions indicated from the current (and previous) investigations, the site is considered as two zones as follows: Zone A: Made Ground Zone B: natural geology Surrounding the perimeter of the Made Ground, predominantly to the south and southwest, shallow foundations may be a suitable option. In these areas the Made Ground was thin enough for foundation excavations to reach the underlying natural ground, or were entirely absent. Where piled foundations are adopted, they should extend through the Made Ground to a suitable depth within either the Upper Tunbridge Wells Sand or Grinstead Clay Member. Deepening of foundations/heave protection is likely to be required to allow for the effects of trees. Floor slabs should be suspended because of depth of Made Ground/presence of medium/high shrinkage potential clay soils. Suspended over a void where within the influencing distance of trees.



Ground Investigation Report

Executive Summary

Roads and pavements	For road / pavement design, a design CBR of >5 % is recommended following completion of the significant earthworks required at the site. Where the CBR is found to be less than 2.5%, the sub-grade may be unsuitable for both the trafficking of site plant and as support for a permanent foundation, without improvement works being undertaken.
----------------------------	--

Sustainable drainage	Soakaway drainage is considered unsuitable for this site.
-----------------------------	---

Buried concrete	Design Sulphate Class - DS-3 and ACEC Class AC-4. Equivalent to Design Chemical Class DC-4.
------------------------	---

Summary of geoenvironmental assessment

Human health	Elevated arsenic, lead, benzo(b)fluoranthene and dibenz(a,h)anthracene from the Made Ground and arsenic and beryllium in the natural soils. Asbestos was positively identified in two samples. The above exceedances should be reviewed against the final cut/fill levels. Where Made Ground remains at formation level, additional remedial measures may be required. The presence of hardstanding / building footprints will mitigate the identified risks.
---------------------	--

Phytotoxicity	CoPC which require further assessment are Boron, Copper, Nickel and Zinc. However, the majority of these exceedances are at depths greater than 0.5m bgl. Cut/fill is proposed across the site which will raise site levels in some area. Where Made Ground remains at formation level, it is not considered to be a suitable growing medium, and therefore clean cover will be required. Construction materials risk assessment
----------------------	--

Controlled Waters	The chemicals of potential concern (CoPC) require further assessment are: zinc, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, fluoranthene and EPH >C16-C35 in the Omnia 2023 soil leachate samples; Nickel in the historical Made Ground water samples; and Nickel and Zinc in the historical natural geology groundwater samples.
--------------------------	---

Construction materials	Plastic or bitumastic products may be at risk from high concentrations of VOC.
-------------------------------	--

Potable water pipes	Brownfield site with organic contamination and barrier pipe is considered suitable for this site. However, confirmation should be sought from the water supply company at the earliest opportunity.
----------------------------	---

Ground gases or vapours	Low risk from ground gases (subject to additional and on-going monitoring) and CS1 conditions apply.
--------------------------------	--

Ecology	Soil leachate and groundwater concentrations exceed environmental quality standards. This has the potential to adversely impact the ponds to the west.
----------------	--

Remediation/mitigation works

Proposed mitigation measures	The methodology for the remediation should be presented in a Remediation Strategy, which will need to be submitted to the warranty provider and the regulatory authorities for approval. Verification reports by a competent independent geo-environmental specialist will be required following completion of any remedial works.
-------------------------------------	--

Earthworks	In order to undertake the proposed cut to fill earthworks and use of excavated materials in earthworks a site specific Earthwork Specification will be required. Verification reports by competent independent geotechnical specialists will be required following completion of any earthworks.
-------------------	---

Future considerations

Further work	Following the ground investigation works undertaken to date, the following further works will likely be required:
---------------------	---



-
- Completion and reporting of the ongoing gas monitoring, hence the conclusions in this report are provisional, subject to the completion of monitoring;
 - Surface water sampling from the off-site pond.
 - Discussion and agreement with utility providers regarding the materials suitable for pipework;
 - Discussions with regulatory bodies and the warranty provider regarding the conclusions of this report;
 - Completion of a Detailed Quantitative Risk Assessment, if required.
 - Discussions with piling Contractors regarding conclusions of this report and design of the piles;
 - Provision of geotechnical design and Earthworks Specification.
 - Preparation of a Remediation Strategy and Verification Plan.
 - Discussions with regulatory bodies and the warranty provider regarding the conclusions of this and future reports.
 - Production of a Materials Management Plan and Environmental Permit.
 - Enablement works, Contractor validation, and associated verification.
 - Construction Phase mitigation works Contractor validation, and associated verification.
 - Upon completion of monitoring regimes, site investigation boreholes should be decommissioned in line with relevant guidance where deemed appropriate by a qualified professional (for example the Environment Agency's Good Practice for Decommissioning Redundant Boreholes and Wells, 2012 or section 2.4.3.2 of NHBC NF94, 2023).
-

This Executive Summary forms part of Stantec UK Limited report number 333701756-STN-XX-XX-RP-GE-0001 and should not be used as a separate document.



1 Introduction

1.1 Terms of reference

In April 2026, Stantec UK Limited (Stantec) was commissioned by Rangeford Villages (the Client) to undertake site investigation, comprising a review of existing Phase 2 Ground Investigation Report information and undertake a Phase 2 supplementary ground investigation at Imberhorne Farm. The site is located in the southeastern field of Imberhorne Farm, East Grinstead, RH19 1TX.

The site is currently an open field.

Stantec understands that the proposed development is to comprise the development of a care village, as well as areas for attenuation.

The investigation works have been undertaken in accordance with Stantec's proposal referenced (26364-STN-XX-XX-FP-GE-0001) and the Client's instructions to proceed (via email 10th April 2026).

1.2 Objectives

The works have been commissioned to support the planning application, to assist with clearing anticipated planning conditions and to assist with the design of the development.

The objectives of the Phase 2 Ground Investigation are:

- to resolve geotechnical and geoenvironmental uncertainties identified in the Phase 1 Desk Study and historical ground investigation works by refining and updating the preliminary Ground Model, based on the ground conditions encountered);
- to identify geo-environmental mitigation requirements to enable development to progress; and
- to provide preliminary geotechnical recommendations for design.

1.3 Scope

The scope of the Phase 2 Ground Investigation comprises:

- a supplementary ground investigation including trial pitting, windowless sampling and cable percussive boring to:
 - obtain data on the ground and groundwater conditions of the site;
 - establish the extent of the Made Ground on site;
 - allow collection of samples for geotechnical and chemical laboratory analysis;
 - allow geotechnical field tests to be undertaken;
 - install gas and groundwater wells;
- gas concentration and groundwater level monitoring;
- groundwater sampling;
- geotechnical and chemical laboratory analysis;
- updating of the preliminary Ground Model;
- preparation of a geotechnical risk register;



- presentation of an initial geotechnical design recommendations;
- formulation of an updated Conceptual Site Model (CSM), including identification of plausible contaminant linkages;
- completion of a generic quantitative risk assessment of identified chemical contaminants to establish 'suitability for use' under the current planning regime;
- discussion of potential environmental liabilities associated with land contamination (soil, water and gas); and
- identification of outline mitigation requirements to ensure the site is 'suitable for use'.

1.4 Available information

The following documents, reports etc have been provided to Stantec by the client for use in the preparation of this report:

- Campbell Reith, June 2022. 'Imberhorne Farm, East Grinstead - Geoenvironmental & Geotechnical Desktop Study'. Ref. 13694-CRH-XX-XX-RP-LQ-7501_DTS-P01;
- Omnia, January 2023. 'Phase II Factual Ground Investigation Report – Proposed Care Village – Imberhorne Farm, East Grinstead, RH19 1TX, Ref: A11898/2.0; and
- Omnia, January 2023. 'Phase II Additional Geo-Environmental Site Assessment, Proposed Care Village – Imberhorne Farm, East Grinstead, RH19 1TX. Ref: A11898/3.0.

It is understood that the Client commissioned assignment of the above documents and Stantec has assumed full reliance can be placed upon their contents. Should this not be the case, Stantec should be informed at the earliest opportunity.

The following documents have been reviewed by Stantec from publicly available sources for use in the preparation of this report:

- Harrison Group Environmental Limited, September 2021. 'Ground Investigation Factual Report – Imberhorne Farm, East Grinstead. Ref: GL24233.

Stantec acknowledges that this document has not been assigned to the Client, and has been used for information purposes only. No formal reliance has been placed upon its content.

1.5 Regulatory context and guidance

The investigation work has been carried out in general compliance with recognised good practice, including (but not limited to) BS 5930:2015+A1:2020, BS 10175:2026 and the AGS (2006) 'Good Practice Guidelines for Site Investigations'.

The geo-environmental section of this report is written in broad accordance with BS 10175:2026 and EA LCRM (2025).

The methods used follow a risk-based approach, the first stage of which is a Phase 1 desk study and field reconnaissance, with potential geoenvironmental risks assessed qualitatively. This is done using the 'source-pathway-receptor contaminant linkage' concept to assess risk as introduced in the Environmental Protection Act 1990 (EPA, 1990). Potential geotechnical risks are also assessed from the Phase 1 desk study and site reconnaissance stage.



Phase 2 comprises intrusive ground investigation work and testing. The factual information from the desk study and the ground investigation are used to develop the Conceptual Site Model (CSM). This CSM is based on a ground model of the site physical conditions and an identification of the possible contaminant linkages. The CSM forms the basis for Generic Quantitative Risk Assessment (GQRA) in accordance with current guidelines. This GQRA might lead to more Detailed Quantitative Risk Assessment (DQRA).

Professional judgement is then used to evaluate the findings of the risk assessments and to provide recommendations for the development.

The geotechnical section of this report is prepared in general accordance with BS EN 1997-1+A1: 2013, BS EN 1997-2:2007 and BS 8004:2015+A1:2020. This report constitutes a Ground Investigation Report (GIR) as described in Part 2 of Eurocode 7 (BS EN 1997-2) (EC7). However, it is not intended to fulfil the requirements of a Geotechnical Design Report (GDR) as specified in EC7.

Where relevant the relevant requirements of the current edition of NHBC Standards have also been applied.

The geoenvironmental and geotechnical aspects are discussed in separate sections. Throughout the report the term 'geotechnical' is used to describe aspects relating to the physical nature of the site (such as foundation requirements). The term 'geoenvironmental' is used to describe aspects relating to ground-related environmental issues (such as potential contamination). However, it should be appreciated that this is an integrated investigation and these two main aspects are inter-related. Designers should take all aspects of the investigation into account.



2 Site Setting

2.1 Site referencing

Table 2-1: Site referencing information

Item	Description
Site name	Imberhorne Farm
Site address	Imberhorne Farm, East Grinstead, RH19 1TX
Site location	Southeastern field of Imberhorne Farm. The National Grid Reference of the approximate centre of the site is 537520,138275.
Site dimensions	Roughly 215m by 270m, rectangular in shape.

Figure 2-1: Site location

(indicated by yellow box)
within the wider site (not
to scale)



Item	Description	N ↑
Figure 2-2: Aerial image (not to scale)	OS licence AC0000817865 	

2.2 Site Description

The following information is based on online aerial imagery and maps and observations from the field during the site investigation between 18 and 26 May 2026.

Table 2-2: Site description

Item	Description
Site access	An access road runs along the northeastern boundary of site, branching off Imberhorne Lane.
Site description	The site comprises a large grass covered field with areas of overgrown vegetation. A broken timber post-and-wire fence extends north–south across the western part of the site, with scattered bushes present along the line of the damaged fence.
Elevation and topography	The site slopes overall from east to west, with elevations reducing from approximately 123m AOD in the east to 112m OAD in the west. The northwestern and southwestern corners lie at around 114m AOD and exhibit a gentle fall towards the centre of the site.
Site boundaries and surrounding land use	The site is bound by trees along the northern, southern, and western boundaries. The eastern boundary comprises an access road off Imberhorne Lane, with additional tree coverage towards the south-east. At the time of the investigation, the site perimeter was enclosed by Heras fencing and an ecological plastic barrier. Residential properties are located to the east and west of the site, with agricultural land to the north and south. Several commercial premises are also present to the west.
Present land use	The land is an empty field used for agricultural purposes.



Item	Description
Previous Land Use	Anecdotal information provided by a local resident at the time of the intrusive investigation suggests that the site was formerly used as a municipal tip where there were no restrictions on the type of waste that could be deposited. The recorded of the landfill/tip is shown in Figure 2-3 below. Further site history information is presented in Sections 3.1 and 3.2 below.
Surface cover and vegetation	The site is predominantly grassed, with patches of overgrown vegetation throughout. Numerous large, mature deciduous trees encompass the site and define its boundaries.
<i>Figure 2-3: Recorded extent of the landfill</i> (reproduced from Groundsure IO, not to scale)	

2.3 Published Geology

The general geology of the site is shown on the BGS GeoIndex and 1:50,000 geological map of Horsham (Sheet 302), with further information provided in the BGS Memoir for Sheet 302.

Table 2-3: Published Geological Sequence

Reference	Location	Stratigraphic Name	Description
Artificial Ground/Topsoil			
Artificial Ground is not indicated to be present on site, although based on the site history and previous investigations, Made Ground associated with historical infilling is expected to be present in the centre of site.			
Solid Geology			
1	On site – Northern half	Upper Tunbridge Wells Sand	Typically comprising thinly bedded silty mudstones, siltstones, silty sandstones and fine-grained sandstones. These weather to a pale yellowish grey or brown colour. The lower boundary typically comprises grey and greenish grey silty mudstones and siltstones, red-mottled in part.



Reference	Location	Stratigraphic Name	Description
2	On site – Southern half	Grinstead Clay Member	Grey to greenish grey mudstones, commonly very silty with subordinate thin beds of siltstone, nodular clay ironstone and shelly limestone. Rootlet horizons and plant-rich beds common. The upper boundary typically comprises a mudstones with the clay commonly weathering to red.

2.4 Hydrology and Hydrogeology

Information relating to the hydrogeological setting of the site is summarised in Table 2-4

Table 2-4: Aquifer system

Stratum	Aquifer Designation	Comments
Artificial Ground		
Made Ground	Unclassified	Artificial ground not included in the classification system. Likely to be moderate to high porosity because of unconsolidated nature, but permeability is likely to be constrained to low, or low to moderate because of poor sorting and where a high clay content is present.
Solid Geology		
Upper Tunbridge Wells Sand	Secondary A Aquifers	Intergranular permeability. Permeability likely to be moderate to high in layers of sand and gravel, with low permeability in clays and silts.
Grinstead Clay Member	Unproductive Strata	Likely to be low permeability as largely cohesive sequence with sands and gravels forming local aquifers yielding small supplies.

The nearest surface water feature is a pond located 20m west of the site, and is located in a Flood Zone 1 (less than 0.1% chance of flooding in any year).

The site is not located within a source protection zone.

The site has negligible risk of groundwater flooding.



3 Summary of previous reports

The previous reports that have been reviewed are listed in Section 1.4. A summary of each report and ground investigation is summarised below. It should be noted that the various reports cover a wider part of the site than just the southeast portion discussed throughout this report. The individual reports should be referred to for review of site coverage.

3.1 Harrison Group Environmental Limited, September 2021. 'Ground Investigation Factual Report – Imberhorne Farm, East Grinstead. Ref: GL24233.

Harrison Group were commissioned by Welbeck Strategic Land II LLP to undertake a ground investigation across Imberhorne Farm, East Grinstead, to provide geotechnical and geo-environmental data in support of a proposed residential development. Key findings from the investigation are summarised below:

- The site comprised agricultural fields (approx. 32 ha), with the Care Village area located in the south-east field used for grazing.
- The investigation included eight dynamic sampling boreholes (to 5.45 m bgl), fifteen trial pits (to 3.20 m bgl), dynamic cone penetrometer testing, soakaway testing and gas/groundwater monitoring. Of the completed exploratory holes, four window sample boreholes, four trial pits and one CBR location were completed in the current subject site.
- Geology is indicated to comprise Upper Tunbridge Wells Sand in the north and Grinstead Clay Member in the south, with no superficial deposits recorded.
- Soils encountered comprised cohesive and granular deposits with variable plasticity (PI typically 7–40%), and variable proportions of sand, gravel, silt and clay.
- Soakaway testing indicated very low infiltration rates, suggesting soakaway drainage may be limited or unsuitable.
- Ground gas and groundwater monitoring installations were installed across the site and monitored over three rounds; groundwater levels were observed to vary and are subject to seasonal variation.
- Environmental testing included soils and groundwater for metals, hydrocarbons, PAHs, asbestos and other contaminants, identifying the need for further assessment within later investigations.



3.2 Campbell Reith, June 2022. ‘Imberhorne Farm, East Grinstead - Geoenvironmental & Geotechnical Desktop Study’. Ref. 13694-CRH-XX-XX-RP-LQ-7501_DTS-P01

A Phase 1 Geoenvironmental and Geotechnical Desk Study was undertaken by Campbell Reith in June 2022 for land at Imberhorne Farm, East Grinstead (c.45.7ha) to support the wider proposed mixed-use residential development comprising approximately 550 dwellings and associated infrastructure. It is understood that the desk study was for the wider Imberhorne Farm site, which included the current southeastern portion of the site discussed throughout this report. Key findings from the desk study are summarised below:

- The site has historically comprised agricultural land since at least 1874, with minimal on-site development. However, a number of potentially contaminative historical and off-site land uses have been identified, including an area of historical inert Made Ground within the south-east of the site (1978–1980), a former sheep wash, a dismantled railway line to the south, and nearby sewage works, vehicle servicing, and industrial estate activities.
- The nearest surface water features are a pond located 20m south of the wider development site. The nearest surface water abstraction is located 420m northwest of the site and is used for spray irrigation.
- There are no groundwater abstractions or source protection zones within 500m of the site.
- Potential geotechnical constraints include variable Made Ground and possible soft alluvial deposits (across the wider development site), both of which may be unsuitable for shallow foundations, in addition to the risk of buried obstructions.
- A preliminary qualitative risk assessment identified potential contamination sources including Made Ground, the historical Made Ground, and adjacent/nearby industrial activities. Overall risks to human health were considered low, with a localised low to moderate risk associated with the historical Made Ground area. Risks to controlled waters were assessed as low to moderate, reflecting aquifer sensitivity and the potential presence of shallow groundwater.
- The desk study concludes that further intrusive ground investigation would be required to confirm ground conditions, quantify potential contamination, and refine the conceptual site model.

3.3 Omnia. January 2023. ‘Phase II Factual Ground Investigation Report – Proposed Care Village – Imberhorne Farm, East Grinstead, RH19 1TX, Ref: A11898/2.0

Omnia were commissioned by Vistry South East to undertake a Phase II intrusive ground investigation within the Care Village parcel of Imberhorne Farm, to inform geotechnical design and environmental assessment. This ground investigation report covers the same portion of the site as is discussed throughout this Stantec report. Key findings from the investigation are summarised below:



- The Site comprised a ~6.01 ha field of open grassland used for sheep grazing at the time of investigation.
- The investigation comprised 19 machine excavated trial pits (to ~3.0 m bgl) and 3 rotary cored boreholes (to ~10 m bgl), with groundwater and gas monitoring undertaken.
- Extensive Made Ground associated with a historical Made Ground was encountered across much of the site, typically between 0.25 m and up to 2.90 m bgl, comprising mixed anthropogenic materials with strong odour.
- Underlying strata comprised clay (interpreted as reworked natural ground), over bedrock of Upper Tunbridge Wells Sand (sandstone) and Grinstead Clay Member (mudstone).
- Perched groundwater was encountered within the Made Ground, with variable seepage conditions and no continuous groundwater strikes recorded in natural strata.
- In-situ Volatile Organic Compounds (VOC) screening recorded negligible concentrations (<0.1 ppm), indicating no significant volatile contamination during field screening.
- Chemical analysis identified elevated concentrations of metals (e.g. copper, lead, zinc), Polycyclic Aromatic Hydrocarbons (PAHs), cyanide and hydrocarbons within soils, reflecting contamination associated with Made Ground materials.
- No asbestos was detected in tested samples; pesticide and herbicide suites were below detection limits.

3.4 Omnia. January 2023. ‘Phase II Additional Geo-Environmental Site Assessment, Proposed Care Village – Imberhorne Farm, East Grinstead, RH19 1TX. Ref: A11898/3.0

Omnia were commissioned by Vistry South East and Rangeford Villages to undertake an additional Phase II Geo-Environmental Site Assessment (interpretive report) for the Care Village development, incorporating previous investigations and risk assessment. Key findings from the assessment are summarised below:

- The site comprises an undeveloped agricultural field underlain by a historical Made Ground, with Made Ground present across much of the Care Village footprint.
- A Tier 1 human health risk assessment identified exceedances of screening criteria for a residential end-use, indicating a need for mitigation measures.
- Recommended mitigation measures included clean soil capping in landscaped areas and installation of gas/VOC protection membranes within building footprints.
- Controlled waters risk was assessed as low, with no significant risk identified under current site conditions.
- Ground gas monitoring indicated Characteristic Situation 2 (CS2), requiring gas protection measures for proposed buildings.



Ground Investigation Report

3 Summary of previous reports

- Concrete exposure classes were assessed as DS-1/AC-1 for natural soils and DS-2/AC-3 for Made Ground, indicating moderate aggressivity.
- Geotechnical assessment indicates variable ground conditions due to Made Ground presence; shallow bearing capacities of 50–100 kPa were identified, but piled foundations are recommended site-wide.
- Historical investigations confirmed the presence of Made Ground materials (1978–1980) and identified contamination including asbestos, metals, PAHs, hydrocarbons and hazardous soils requiring management.
- Additional works are recommended, including delineation of asbestos hotspots and preparation of a Remediation Method Statement (RMS), with potential requirement for a Piling Risk Assessment if piling penetrates the Made Ground liner.



4 Preliminary Ground Model

The preliminary ground model is based on the information on the ground conditions presented in previous sections and integrates site-specific data (where available) with regional geological desk-based information.

The preliminary Ground Model is discussed below.

Table 4-1: Preliminary Ground Model

Strata	Expected Thickness (m)	Description	Comments
Artificial Ground/Topsoil			
Topsoil	0.5	Soft light brown sandy silt with frequent rootlets. Sand is fine to coarse.	-
Made Ground	2.45	Dark grey and black sandy angular gravel of glass, plastic, metal and fabric, soft brown sandy clay with rare cobbles of brick, black angular gravel of bottles, roots, wood, plastic, tile, and brick.	Visual and olfactory indicators of contamination throughout, in the form of staining and odours. Encountered in exploratory holes TP306, TP309, TP310, TP310a, TP311, TP312, TP315, TP316, TP317, RC302 and RC303, covering the centre of the site.p ¹
Possible reworked natural ground	1.7	Soft to firm grey mottled brown and black silty and sandy clay.	Only encountered in Omnia, 2023 within selected exploratory holes in the central area of the site..
Solid Geology			
Upper Tunbridge Wells Sand	>10.0	Orangish brown to reddish brown slightly clayey sandy gravel and gravelly sand, containing angular to subrounded sandstone, siltstone and minor friable clay. Bedrock was encountered from 3.60m to 10.00 m bgl and comprised moderately strong to strong, thinly laminated to laminated fine sandstone, varying from slightly weathered light orange and grey banded rock to fresh light orangish grey and light orange sandstone.	Encountered in TP301-TP308 ¹

¹ Omnia. January 2023. 'Phase II Factual Ground Investigation Report – Proposed Care Village – Imberhome Farm, East Grinstead, RH19 1TX, Ref: A11898/2.0



Strata	Expected Thickness (m)	Description	Comments
Grinstead Clay Member	>10	Soft to stiff grey and orangish brown mottled silty clay, locally slightly gravelly with angular mudstone lithorelics, together with occasional dark grey slightly clayey sandy gravel of siltstone. Bedrock was encountered from 6.20m bgl to the maximum explored depth of 10.00 m bgl and comprised weak to moderately strong, thinly laminated mudstone, varying from highly fractured and weathered grey mudstone with frequent orange alteration staining to slightly weathered light grey mudstone.	Encountered in TP309-TP321 in the south and southeast of the site ¹

The initial ground model is topsoil overlying Made Ground in the centre of the site, topsoil overlying the Upper Tunbridge Wells Sand in the northern area (outside of the Made Ground), and topsoil overlying the Grinstead Clay in the southern area of the site (outside of the Made Ground). The boundary between the Upper Tunbridge Wells Sand and Grinstead Clay Member is anticipated to run through the centre of the site, with the Upper Tunbridge Wells Sand likely thickening towards the north. It should be noted that the Upper Tunbridge Wells Sand is likely to have been partially extracted prior to filling, and thicknesses may vary where the Made Ground material is present. Both the Upper Tunbridge Wells Sand and Grinstead Clay Member were unproven to a maximum depth of 10m bgl.

The Omnia 2023 ground investigation noted that no groundwater was encountered, however seepages were encountered during the trial pitting and perched water was encountered within the fill material varying from slow ingress to very fast water ingress. Post-fieldwork monitoring indicated groundwater levels to be approximately 1.83m to 2.88m bgl within RC301 to RC303 within the natural deposits. Groundwater was encountered within TP02 as part of the Harrison Group ground investigation² at 0.7m bgl (Made Ground) and was monitored to be between 0.79m and 3.13m bgl during post-fieldwork monitoring.

² Harrison Group Environmental Limited, September 2021. 'Ground Investigation Factual Report – Imberhorne Farm, East Grinstead. Ref: GL24233.



5 Ground hazards

5.1 Preliminary geotechnical hazard identification

Potential geotechnical hazards were assessed as part of the previous desk study in accordance with the general requirements of ICE/DETR Document 'Managing Geotechnical Risk' and the HE documents CS 641 and CD 622.

Table 5-1 sets out the identified geotechnical risks and hazards which are associated with the site.

Table 5-1: Preliminary geotechnical hazard identification

Hazard	Hazard Plausible	Hazard Unlikely	Comment
Uncontrolled Made Ground (variable strength and compressibility).	✓	-	The site is underlain by Made Ground.
Soft / loose compressible ground (low strength and high settlement potential).	✓	-	The site is underlain by Made Ground
Shrinkage / swelling of the clay fraction of soils under the influence of vegetation.	✓	-	The site is underlain by Made Ground which may have cohesive components, and underlain by the Grinstead Clay Member.
Variable lateral and vertical changes in ground conditions.	✓	-	The Made Ground material is likely to vary laterally and vertically.
Attack of buried concrete by aggressive ground conditions.	✓	-	Sulphate bearing soils may be present within the Made Ground.
Obstructions.	✓	-	Obstructions should be anticipated within the Made Ground.
Shallow groundwater.	✓	-	Shallow groundwater has been encountered on site during previous ground investigations.
Changing groundwater conditions.	✓	-	Shallow groundwater may be subject to seasonal variations.
Running sands and / or loose Made Ground, leading to difficulty with excavation and collapse of side walls.	✓	-	There may be loose sand within the Upper Tunbridge Wells Sand and within the Made Ground
Earthworks – poor bearing capacity of new fill.	✓	-	The site is underlain by Made Ground and as such earthworks will likely be required.



Hazard	Hazard Plausible	Hazard Unlikely	Comment
Earthworks – unsuitability of site won material to be reused as fill	✓	-	The site is underlain by Made Ground and as such earthworks will likely be required.
Existing below ground structures to remain (on or off-site tunnels, foundations, basements, and adjacent sub-structures).	-	✓	No below ground structures to remain on site.
Risk from erosion or flooding.	-	✓	The site is at low risk of groundwater flooding.
Slope stability issues – general slopes.	✓	-	The site slopes down from east to west and is formed of varying thicknesses of Made Ground.
Slope stability issues – retaining walls.	✓	-	Significant cut and fill will be required as part of the development.

5.2 Potential development elements affected

Development elements potentially affected by geotechnical hazards have been identified as:

- Building foundations.
- Building floor slabs.
- Roads and pavements.
- Services.
- General slopes.
- Retaining walls.
- Gardens.
- Construction staff, vehicles and plant operators.
- Concrete below ground.
- Earthworks control, inability to place and compact fill.
- Insufficient fill to complete earthworks.

Health and safety risks to site Contractors and maintenance workers have not been assessed and will need to be considered separately during design.

The above plausible geotechnical hazards and development elements affected have been carried forward for investigation and assessment.



6 Initial Conceptual Site Model and Preliminary Risk Assessment

6.1 Introduction

The initial Conceptual Site Model (CSM) and Preliminary Risk Assessment incorporates evidence from the site walkover, the Desk Study, and previous investigations carried out at the site. The formulation of an initial CSM is a key component of the LCRM methodology for assessing geoenvironmental risk, and incorporates the Preliminary Ground Model of the site physical conditions (Section 4) and the identification of potential contaminant linkages.

The available information has used to identify geo-environmental hazards and to establish potential contaminant linkages based on the source-pathway-receptor (S-P-R) approach. A viable contaminant linkage requires all the components of an S-P-R to be present. If only one or two are present, there is no linkage and no further assessment is required.

Health and safety risks to site development contractors and maintenance workers have not been assessed as part of this study and will need to be considered separately.

6.2 Potential contaminants

For the purpose of this assessment the potential contaminants have been separated according to whether they are likely to have originated from an on-site or off-site source.

6.3 Potential on-site sources of contamination

- Made Ground possibly containing elevated concentrations of petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), metals, metalloids, asbestos, and Asbestos Containing Materials (ACMs) (S01).
- Organic materials in the Made Ground producing ground gases (carbon dioxide and methane) and vapours (S02).

6.4 Potential off-site sources of contamination

No potential off-site sources of contamination have been identified. The railway line located adjacently south of the site was discontinued circa 1975 and is considered to pose a low to negligible risk. Imberhorne Farm is also located down hydraulic gradient of the site (to the west) and is therefore not considered to pose a risk.

6.5 Potential receptors

The following potential receptors in relation to the proposed land use have been identified.

- People (site end users, neighbours) (R01).
- Development end use (buildings, utilities and landscaping) (R02).
- Groundwater: Secondary A aquifer status of the Upper Tunbridge Wells Sand (R03).
- Surface water: Aquatic ecosystems (R04)



- Plant life (R05).

6.6 Potential pathways

The following potential pathways have been identified.

- Ingestion, skin contact, inhalation of dust and outdoor air by people (P01).
- Methane ingress via permeable soils and/or construction gaps (P02).
- Root uptake by plants (P03).
- Migration of contaminant via leachate migration through the unsaturated zone in the Upper Tunbridge Wells Sand (P04).
- Migration of contaminant from the groundwater within the Secondary A aquifer of the Upper Tunbridge Wells Sandstone (P05).
- Surface water via overland flow (P06).

6.7 Summary of potential contaminant linkages

The above sources, pathways and receptors have been identified as part of the previously reported Preliminary Risk Assessment in accordance with Stage 1 of LCRM (2025). These are considered to be plausible in the context of this site and the available information, and have been carried forward for investigation and assessment.

Table 6-1: Initial CSM

Source	Pathway	Receptor	Risk Level	Comment
Made Ground possibly containing elevated concentrations of petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), metals, metalloids, asbestos, and Asbestos Containing Materials (ACMs) (S01)	Ingestion, skin contact, inhalation of dust and outdoor air by people (P01)	Site users. (R01)	Moderate	The site is understood to be underlain by Made Ground which may contain metals, metalloids, asbestos fibres, ACM, PAH and petroleum hydrocarbons and present a risk to human health and controlled waters. Previous ground investigation works have identified elevated concentrations of contaminants in soils and groundwater.
		Neighbours. (R01)		
	Leaching through unsaturated zone (P04)	Groundwater and possible abstractors. (R03)		
	Surface run-off. (P06)	Aquatic ecosystems. (R04)		
	Base flow from contaminated groundwater (P05)	Possible abstractors. (R03)		
	Root uptake (P03)	Landscape and garden planting (R05)		
Organic materials in the Made Ground materials producing ground gases	Methane ingress via permeable soils and/or	Site users. (R01)	Moderate	The Made Ground is likely to contain organic materials which may result in elevated concentrations of carbon dioxide and methane. Previous
		Buildings on site (R02)		



Source	Pathway	Receptor	Risk Level	Comment
(carbon dioxide and methane) and vapours (S02)	construction gaps (P02)	Neighbours. (R01)		ground investigation works indicate characteristic situation 2 conditions, subject to further monitoring.

7 Ground investigations

7.1 Site works

The ground investigation works, including the rationale which was based on the findings of the preliminary risk assessment is summarised in Table 7-1. For the investigation rationale of the historical investigations, please refer to the historical reports separately.

The fieldwork took place between 18th and 26th May 2026. The ground investigation locations were surveyed in using a handheld GPS and are shown on the Exploratory Hole Location Plan (Stantec Drawing 333701756-STN-XX-XX-DR-GE-0001-P01) in Appendix A.

The Omnia ground investigation took place between 28th November and 2nd December 2022. The exploratory Hole Location Plan can be found in the historic report.

The logs, including details of ground conditions, soil sampling, in situ testing and any installations, are also presented in Appendix B.

The weather conditions during the Stantec fieldwork and for the previous week were overcast and rainy, followed by a heat wave.

Table 7-1: Summary of site works

Activity	Method	No.	Name	Depth (m bgl)	In situ tests	Rationale
Drilling, Pitting and Probing						
Boreholes	Dynamic windowless sampling with rotary follow on (Omnia)	3	RC301 – RC303	10.00	SPT	Establish ground conditions beneath Made Ground to inform piled foundation design and to install monitoring pipe to establish groundwater levels and flow direction.
	Cable percussive (Stantec)	2	CP401 – CP402	15.00	SPT	Establish ground conditions beneath Made Ground to foundation design and to install monitoring pipe to establish groundwater levels and monitor gas levels.
	Windowless Sampler (Stantec)	18	WS401 – WS417	1.65 – 5.45	SPT	Establish ground conditions beneath Made Ground for foundation design and to install monitoring pipe to establish groundwater levels and monitor gas levels.



Ground Investigation Report

7 Ground investigations

Activity	Method	No.	Name	Depth (m bgl)	In situ tests	Rationale
Trial pits	Machine - JCB 3CX (Omnia)	21	TP301 – TP321	2.00 – 3.00	Hand shear vane (HSV)	For general site coverage and collection of samples
	Machine - JCB 3CX (Stantec)	7	TP401, TP402, TP403, TP406, TP410, TP411, TP412	1.00 – 2.30	Hand shear vane (HSV)	To identify the extent of the Made Ground and collection of samples

Wells for monitoring groundwater levels and ground gas concentrations, and to facilitate the sampling of groundwater, were installed in a number of the windowless sampler, rotary and cable percussion boreholes. A summary of the monitoring well installations is presented in Table 7-2.

Table 7-2: Summary of monitoring installations (historical and Stantec 2026)

Location	Ground level (m OD)	Standpipe / piezometer diameter	Screen top and base depth (m bgl)	Screen top and base elevation (m OD)	Strata targeted
CP401	119.49	50	5.00 to 10.00	114.49 to 109.49	Grinstead Clay Member (GCM)
CP402	119.99	50	9.00 to 15.00	110.99 to 104.99	GCM
RC301	121.80	50	4.00 to 10.00	117.80 to 111.80	Upper Tunbridge Wells Sand (UTWS)
RC302	118.31	50	4.00 to 10.00	114.31 to 108.31	GCM
RC303	113.19	50	5.00 to 10.00	108.19 to 103.19	GCM
WS401	114.98	50	1.00 to 2.50	113.98 to 112.48	UTWS
WS403	121.27	50	1.00 to 2.50	120.27 to 118.77	GCM
WS404	112.16	50	0.50 to 5.00	111.66 to 107.16	GCM
WS406	117.59	50	0.50 to 3.00	117.09 to 114.59	Made Ground
WS408A	113.58	50	0.50 to 2.50	113.08 to 111.08	GCM
WS410	117.31	50	0.50 to 3.00	116.81 to 114.31	Made Ground
WS411	120.75	50	0.50 to 2.50	120.25 to 118.25	Made Ground
WS413	114.52	50	0.50 to 2.50	114.02 to 112.02	GCM
WS416	121.70	50	0.50 to 2.00	121.20 to 119.70	Made Ground
WS417	123.23	50	0.50 to 1.50	122.73 to 121.73	Made Ground



7.2 Geo-environmental testing

7.2.1 Sampling strategy and protocols

Exploratory hole positions were determined by reference to the site conditions and uncertainties identified in the previous ground investigation works.

Certain specific features, such as the Made Ground, were targeted for specific investigation, but a reasonably even spacing was used for the remainder of the site.

Samples were taken, stored and transported in general accordance with BS 10175:2011+A2:2017.

7.2.2 Site screening tests

A photoionization detector (PID) (MiniRAE Lite) was used during the fieldwork to screen samples. The PID readings are detailed on the exploratory hole logs in Appendix B.

7.2.3 Geo-environmental monitoring

Gas monitoring boreholes have been monitored on four occasions. The results are presented in Appendix C. Monitoring is ongoing and this report will be updated on completion of the monitoring.

7.2.4 Geo-environmental laboratory analyses

The chemical test certificates for testing undertaken as part of Stantec's investigation are provided in Appendix E and summarised in the table below. Wherever possible, UKAS and MCERTS accredited procedures have been used.

The chemical test certificates for testing undertaken as part of historical investigations are provided in the relevant reports.

The geo-environmental analyses undertaken on soils are summarised in Table 7-3.

Table 7-3: Geo-environmental analyses of soils or other solids from Stantec 2026 ground investigation

Determinand Suite	Topsoil	Made Ground	Upper Tunbridge Wells Sand	Grinstead Clay Member
Stantec minimum suite of determinands for solids	1	8	1	2
Volatile organic compounds (VOC target list) by HS-GC/MS	-	4	-	-
Semi-volatile organic compounds (SVOC target list) by GC-MS	-	4	-	-
WAC Full Solid Suite	-	2	-	-

*Stantec minimum soil suite comprises: As, B (water soluble), Be, Cd, Cr (total), Cr (VI), Cu, Hg, Ni, Pb, S (elemental), Se, V, Zn, cyanide (total), sulphide, pH, asbestos fibres, speciated polynuclear aromatic hydrocarbons (PAH, by GC-FID), total phenols and fraction of organic carbon

In addition to the above, Omnia also undertook the following suite of testing.



Ground Investigation Report

7 Ground investigations

Table 7-4. Geo-environmental analyses of soils or other solids from Omnia 2022 ground investigation

Determinand Suite	Topsoil	Made Ground	Upper Tunbridge Wells Sand	Grinstead Clay Member
CLEA Metals	3	15	2	7
Asbestos Fibres in soil				
Speciated Polycyclic Aromatic Hydrocarbons				
Banded Total Petroleum Hydrocarbons				
Cyanide				
Phenols				
Total Organic Carbon				
Acid herbicides	3	-	-	-
Combined Pesticides				
pH	3	15	2	7

The geo-environmental analyses undertaken as part of Stantec's investigation on waters are summarised in Table 7-5.

Table 7-5: Geo-environmental analyses of waters, leachates or other liquids from Stantec 2026 ground investigation

Determinand Suite	Soil leachates	Groundwater	Surface water
Stantec minimum suite of determinands for waters	-	3	-
Speciated aliphatic and aromatic banding Total petroleum hydrocarbons by HS-GC/MS and GC/FID (Stantec Tier 2 TPH Suite)	-	3	-
Benzene, toluene, ethylbenzene and xylene (BTEX) by HS-GC/MS	-	3	-
MTBE (Methyl Tertiary Butyl Ether) by HS-GC/MS	-	3	-

The geo-environmental analyses undertaken as part of Omnia's 2022 investigation on waters are summarised in Table 7-6.



Ground Investigation Report

7 Ground investigations

Table 7-6. Geo-environmental analyses of waters, leachates or other liquids from Omnia 2022 ground investigation

Determinand Suite	Soil leachates	Groundwater
CLEA Metals	1	3
Speciated Polycyclic Aromatic Hydrocarbons		
Banded Total Petroleum Hydrocarbons		
Cyanide		
Phenols		
Semi Volatile Organic Compounds		
Volatile Organic Compounds	-	
Total Hardness		
7 PCBs	-	



7.3 Geotechnical testing

7.3.1 In-situ geotechnical monitoring

The results of geotechnical monitoring undertaken by Stantec are provided in Appendix D.

7.3.2 Geotechnical laboratory testing

The geotechnical tests undertaken by Stantec are summarised in Table 7-7 and the test certificates are provided in Appendix D. Wherever possible, UKAS accredited procedures have been used.

The geotechnical tests undertaken as part of historical investigations are provided in the relevant reports.

Table 7-7: Summary of sample numbers for geotechnical tests

Test	Made Ground	Upper Tunbridge Wells Sand	Grinstead Clay Member
Natural moisture content	- (2)	8 (1)	21 (2)
Atterberg limits	- (1)	8 (1)	16 (2)
Particle size distribution	2	4 (3)	-
Sulphate and aggressive chemical environment classification for buried concrete classification (full BRE SD1 suite)	1	4	9
Single stage undrained triaxial compressive strength	-	2	-
Organic Matter	-	2	-
Unconfined compressive strength	-	(2)	-
Point load	-	(2)	(2)

Numbers in (brackets) denote number of tests undertaken by Omnia in 2022.



8 Ground investigation records and data

8.1 Physical ground conditions

8.1.1 Summary of strata encountered

The following presents a summary of the properties of the ground and groundwater conditions encountered, based on field observations, interpretation of the field data and laboratory test results, taking into account drilling, excavation and sampling methods, transport, handling and specimen preparation.

All relevant data from the Stantec investigation discussed in Section 4 as well as any reliable data from previous investigations noted in Section 0 are used from this point forward.

Details of the Stantec ground investigation works are provided in the logs in Appendix B, a summary of the ground encountered, including the Omnia ground conditions, is presented in Table 8-1 and the individual strata are described in the sections below. Relevant cross-sections and contour plans are presented in Appendix A.

Table 8-1: Strata encountered

Stratum	Depth to top, m bgl (mOD)	Depth to base, m bgl (mOD)	Thickness (m) (range)	Thickness (m) (average)
Topsoil	0.00 (112.16 to 123.83)	0.20 to 0.50 (111.86 to 123.53)	0.20 to 0.50	0.31
Made Ground	0.00 to 0.40 (101.80 to 123.53)	0.50 to 3.50 (101.30 to 122.83)	0.40 to 3.50	1.71
Upper Tunbridge Wells Sand*	0.30 to 3.40 (101.30 to 122.83)	1.50 to >10.00* (<91.80 to 121.83)	1.00 to >9.50*	Not proven
Grinstead Clay Member*	0.20 to 5.90 (110.49 to 121.75)	1.20 to >15.00 (<103.19 to 119.23)	0.90 to >10.00	Not proven

*Full depths not proven in these investigations.

8.1.2 Topsoil

During the Stantec investigation, topsoil was encountered from ground level across the entire site, although Omnia did not record its presence in exploratory holes TP309, TP310, TP310A, TP311, TP312, TP316 and TP317.

The topsoil comprised brown sandy slightly gravelly clay to sandy silt with frequent rootlets.

For the purposes of this report, topsoil is defined as the upper layer of an in-situ soil profile, usually darker in colour and more fertile than the layer below (subsoil), which is a product of natural chemical, physical, biological and environmental processes, but does not imply compliance with BS 3882:2015.



Reuse of topsoil as a growing medium at the site should be determined by the landscape architect or the landscape contractors.

8.1.3 Made Ground

Below the topsoil across the site or locally at ground level in some areas, Made Ground was encountered predominantly in the central area of the site, with a smaller extent identified towards the western area.

The Omnia report differentiates the Made Ground into three main types, a presumed capping layer, fill material and presumed basal clay liner. However, the Omnia report also notes that the presumed capping layer is not laterally extensive across the fill material. In addition, the presumed basal clay liner was recorded by Omnia to be probable worked natural ground. As such, Stantec have not differentiated between possible capping and the Made Ground material (assumed to be one Made Ground stratum) and have also interpreted the basal clay liner to be natural ground, albeit potentially reworked.

The Made Ground is located directly beneath topsoil (where present), generally to depths of between 0.50m bgl and 3.50m bgl).

The Made Ground comprised a mixture of domestic refuse, commercial and industrial waste and demolition waste, including plastic, metal, paper, wire, pipes, glass bottles, clothing, partially decomposed wood, animal bones and ash.

The material generally consists of orangish brown slightly sandy slightly gravelly clay with anthropogenic material or black slightly gravelly clayey fine to coarse sand with anthropogenic material.

Suspected Asbestos Containing Material was encountered in WS416.

8.1.4 Upper Tunbridge Wells Sand

Upper Tunbridge Wells Sand (UTWS) was encountered underlying the Made and/or topsoil in the northern and central sections of the site. In locations where the base was proven UTWS is between 1.20m and 2.60m thick, with an average thickness of 1.71m.

This stratum generally consisted of firm to stiff grey mottled orangish brown and yellowish brown sandy slightly gravelly clay, and medium dense brown gravelly clayey fine to coarse sand. Gravel comprised fine to coarse grained extremely weak to weak sandstone and extremely weak to weak mudstone.

8.1.5 Grinstead Clay Member

Grinstead Clay Member (GCM) was encountered underlying the Topsoil and/or Made Ground in the southern half of site, and below the UTWS in the central area of site. The base of this stratum was not proven.

This unit generally consisted of stiff brown mottled red slightly sandy clay, very stiff dark grey slightly sandy CLAY, firm orangish brown mottled grey slightly sandy slightly gravelly clay with iron-stained sandstone and mudstone, and firm to stiff multicoloured sandy clay with rootlets and occasional plant matter at shallow depth. Locally, bands of sandstone were encountered at depth within this unit.



Fissuring and shear surfaces were also observed. Fissures were extremely closely spaced and randomly orientated. Shear surfaces were waxy and undulating.

8.2 Visual and olfactory indicators of contamination (soil)

In addition to the more common man-made constituents (ash, clinker, plastic, etc), described above in Section 8.1, visual and olfactory indicators of contamination was noted in a number of locations, summarised in Table 8-2. Visual and olfactory indicators of contamination were not noted during the Omnia investigation.

Table 8-2: Visual and olfactory indicators of contamination - soils

Stratum	Location	Depth (m bgl)	Description
Made Ground	TP406	1.4-1.7	Strong hydrocarbon odour
	TP412	0.9-1.9	Strong hydrocarbon odour
	WS416	0.3-1.2	Suspected Asbestos Containing Materials (ACM)
	WS416	1.2-2.0	Strong hydrocarbon odour
Upper Tunbridge Wells Sand	TP406	0.9-1.3	Black staining

8.3 Soil Organic Carbon Content

The soil organic content for each stratum is summarised in Table 8-3 below.

Table 8-3: Soil organic carbon content

Stratum	Min (%)	Max (%)	Average (%)
Topsoil	1.65	-	-
Made Ground	0.5	11.9	5.18
Natural geology (Upper Tunbridge Wells Sand and Grinstead Clay Member)	0.57	0.62	0.62



8.4 Groundwater

8.4.1 Groundwater observations and levels

Groundwater encountered during the investigation is listed in Table 8-4. A groundwater observation represents the depth at which groundwater was first observed and is likely to be deeper than the actual water table level at that location.

Table 8-4: Groundwater encountered during site works

Stratum	Date	Location	Fieldwork		Comment
			Groundwater observation (m bgl)	Rose to after 20 mins (m bgl)	
Grinstead Clay Member	18/05/2026	CP401	7.3	6.5	Fast inflow
		CP401	12.5	10.8	Fast inflow
		CP402	12.0	6.5	Fast inflow
	22/05/26	WS406	3.0	-	-
	21/05/26	WS414	1.5	-	-

On completion of drilling selected exploratory holes, monitoring installations were installed to allow post-fieldwork groundwater and ground gas monitoring. Table 8-5 summarises the locations and construction of these wells, as well as the target strata.

Table 8-5: Monitoring well response zones

Location	Monitoring Well Response Zone		Target Stratum
	Top (m bgl)	Base (m bgl)	
CP401	5.00	10.00	Grinstead Clay Member
CP402	9.00	15.00	Grinstead Clay Member
WS401	1.00	2.45	Upper Tunbridge Wells Sand
WS403	1.00	2.45	Grinstead Clay Member
WS404	0.50	5.45	Grinstead Clay Member
WS406	0.50	3.00	Made Ground
WS408A	0.50	2.45	Grinstead Clay Member
WS410	0.50	3.00	Made Ground
WS411	0.50	2.50	Made Ground
WS413	0.50	2.45	Grinstead Clay Member
WS416	0.50	2.00	Made Ground
WS417	0.50	1.50	Made Ground



Groundwater levels recorded during post-fieldwork monitoring are summarised in Table 8-6. It should be noted that at the time of this report only 4 of the scheduled 6 rounds of gas and groundwater monitoring (between 9th June and 23rd July 2026) has been completed at the site. Further data will be included in this section when it becomes available.

Table 8-6: Groundwater level data summary

Stratum	Location	Post-fieldwork monitoring	
		Depth to groundwater (range) (m bgl)	Groundwater elevation (range) (mOD)
Made Ground	WS406	2.69 to 2.80	114.9 to 114.79
	WS410	2.35 to 2.39	114.96 to 114.92
	WS411	2.08 to 2.16	118.67 to 118.59
	WS416	Dry	-
	WS417	Dry	-
Upper Tunbridge Wells Sand	WS401	2.52 to dry	112.46 to 112.13
Grinstead Clay Member	CP401	2.79 to 3.08	116.70 to 111.41
	CP402	4.86 to 5.39	115.31 to 114.60
	WS403	Dry	-
	WS404	2.20 to 2.58	109.96 to 109.58
	WS408A	2.45 to 2.59	111.13 to 110.99
	WS413	1.42 to 1.87	113.10 to 112.65

8.4.2 Infiltration tests

Infiltration testing was not undertaken as part of the 2026 Stantec ground investigation works. Infiltration rate testing was undertaken as part of the Harrison Group Environmental ground investigation works in 2021 however they were completed across the wider development site. Three soakaway test locations were completed, all of which indicated no soil infiltration. For full results refer to the Harrison Group Environmental report.

8.4.3 Groundwater summary

In general, limited perched groundwater was encountered within the Made Ground.

Groundwater was also encountered within the Grinstead Clay at a variety of depths. The installations within the window sample holes recorded the presence of groundwater at shallow depth within this stratum, generally between 1.40m and 2.50m below ground level. The monitoring wells installed at greater depth within the cable percussive holes targeted water strikes within the Grinstead Clay Member at depth. The subsequent monitoring data indicated water levels resting above the top of the slotted response zone of the installation, suggesting groundwater may be held under sub-artesian conditions at depth within the Grinstead Clay Member. It was also noted that two of the three



groundwater strikes at depth in CP401 and CP402 were associated with recorded sandstone layers within the clay.

Further analysis of the groundwater regime at the site will be undertaken once the final monitoring visits have been completed.

Based on the data available to date, groundwater appears to flow towards the west following the topography of the site. It is likely that groundwater flows towards the off-site pond along the western boundary of the site. A groundwater contour plot is provided in Appendix A.

Previous ground investigations indicate some visual and olfactory evidence of contamination in the groundwater with an oily sheen being observed during the fieldwork.

8.5 Ground gases (carbon dioxide and methane)

Records from the gas monitoring boreholes are presented in Appendix C and summarised in Table 8-7.

To date four monitoring visits have been undertaken, with a further two visits to be undertaken as part of the current commission.

Table 8-7: Range of ground gas data

Stratum	Methane (%)	Carbon dioxide (%)	Oxygen (%)	Steady flow rate (l/hr)
Made Ground	<0.00 to 1.7	3.8 to 13.0	0.5 to 15.3	<0.00 to 0.3
Natural geology	<0.00	0.6 to 6.6	15.1 to 20.6	<0.0 to 0.5

8.6 Organic vapours

The PID results are provided on the logs in Appendix B. In both the Stantec 2026 ground investigation and historical ground investigation works, there were no significantly elevated PID results above background levels.

8.7 Updated ground model

The initial ground model, presented in Section 4 has been updated based on the Stantec ground investigation. The strata encountered partially reflected the anticipated ground model, and in summary the Made Ground extends across a wider area of the site than previously detailed, this is shown on Stantec drawing 333701756-STN-XX-XX-DR-GE-0006-P01. The Made Ground has an average thickness of 1.7m across the site beneath the topsoil. The Made Ground is, in most locations, directly overlying the Grinstead Clay Formation. In the north of the site the Made Ground is overlying the Upper Tunbridge Wells Sand. The Upper Tunbridge Wells Sand becomes thicker to the north, northeast and northwest and becomes absent towards the south of the site, where only the Grinstead Clay was encountered.

Previous investigations, notably the Omnia 2023 report, interpreted that some of the underlying clay beneath the Made Ground may be reworked natural ground. During the Stantec 2026 ground investigation, no notable discrepancy was identified between the clay directly beneath the Made Ground



and the clay that extends to depth as part of the natural stratum. As such, the Stantec interpretation is that the Made Ground lies directly on the natural clay strata.

Contour plots for the thickness of the Made Ground, top of the Made Ground and base of the Made Ground are provided in Appendix A. The Made Ground is thickest in the centre of the site, with a maximum thickness of 2.90m within WS410. The Made Ground comprises a mixture of domestic refuse, commercial and industrial waste and demolition waste, including plastic, metal, paper, wire, pipes, glass bottles, clothing, partially decomposed wood, animal bones and ash.

There is shallow groundwater within the Made Ground and natural stratum, with an average groundwater level of 2.6m bgl, which is topographically controlled and flows towards the west

Geological cross-sections are shown in on Stantec Drawing 333701756-STN-XX-XX-DR-GE-0008-P01 in Appendix A.



9 Geotechnical data

9.1 Introduction

Laboratory test results are contained in Appendix C with in situ test results shown on the relevant exploratory hole logs in Appendix B. The following sections summarise the main findings and provide interpretation where appropriate.

9.2 Water Content

Table 9-1 summarises the results of water content testing undertaken during the 2026 investigation and as part of the historic investigations carried out by Omnia.

Table 9-1: Water Content

Stratum	No of Tests	Natural Water Content Range (%)
Stantec 2026 Results		
Upper Tunbridge Wells Sand	9	16.1 to 28.1
Grinstead Clay Member	20	9.9 to 31.3
Omnia 2023 Results		
Upper Tunbridge Wells Sand	1	19
Grinstead Clay Member	3	23 to 68



9.3 Plasticity

The volume change potentials in terms of NHBC Standard (Chapter 4.2) with respect to building near trees have been determined from the results of plasticity index tests on samples of soil. These are summarised in Table 9-2 and presented graphically on Figure 3.

Table 9-2: Volume change potential

Stratum	No. of tests	Plasticity Index			Modified Plasticity Index			Plasticity designation	Volume Change Potential
		Min.	Max.	Av.	Min.	Max.	Av.		
Stantec 2026 Results									
Upper Tunbridge Wells Sand	8	13	31	17	13	31	17	Low to medium	Low
Grinstead Clay Member	16	10	40	24	10	40	21.3	Low to high	Low to medium
Omnia 2023 Results									
Made Ground	1	34	-	-	34	-	-	High	Medium
Upper Tunbridge Wells Sand	1	17	-	-	16.7	-	-	Medium	Low
Grinstead Clay Member	2	22	22	-	13	16.2		Medium	Low



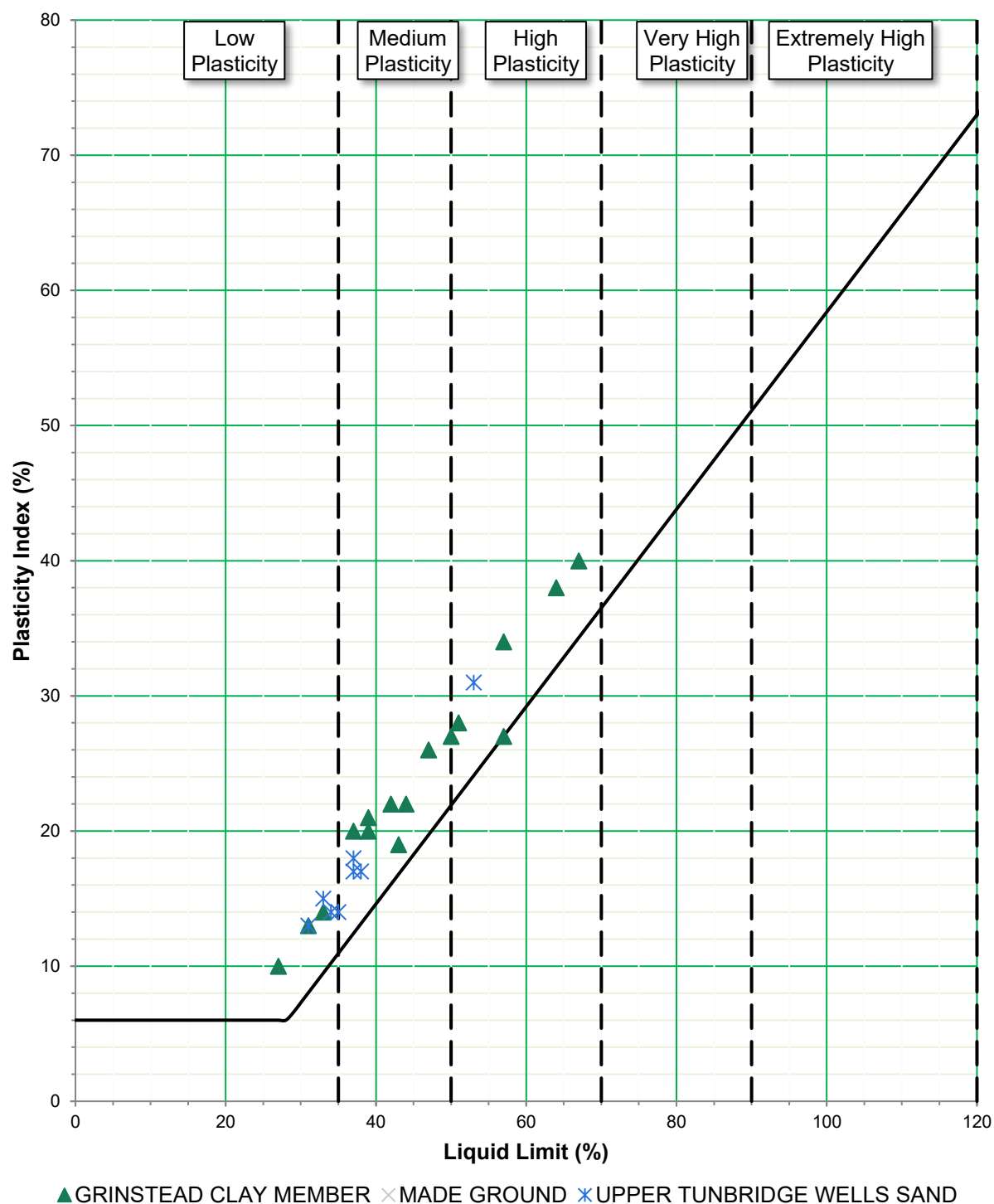


Figure 9-1: Plasticity versus liquid limit (Stantec 2026 data)

9.4 Particle size distribution

Particle Size Distribution test (PSDs) results are summarised in Table 9-3 and summary descriptions and PSD plots of the material analysed are presented in Appendix C.



Table 9-3: PSD results summary

Stratum	No. of tests	Silt/Clay %	Sand %	Gravel %	General description
Stantec 2026 Results					
Made Ground	2	17 to 40	25 to 51	32 to 35	Clayey silty gravelly sand
Upper Tunbridge Wells Sand	4	38 to 90	10 to 62	0 to 11	Slightly sandy silt/clay
Omnia 2023 Results					
Upper Tunbridge Wells Sands	3	51 to 80	10 to 18	8 to 34	Sandy gravelly silt/clay

9.5 In-situ SPT data

Table 9-4 summarises information pertaining to the SPT N-values for cohesive and granular material, and shear strength of the soils according to geological stratum. Factual results are summarised for laboratory tests, field tests (e.g. hand shear vane) and corrected Standard Penetration Tests (SPT N₆₀). Where the SPT N₆₀ is used to infer shear strength by published correlation, this is also tabulated. For historical SPT results, refer to the logs within the reports separately.

Table 9-4: Soil strength results and derived values

Stratum	No. of tests	SPT N ₆₀ (N-value) (range)	c _u (kPa)	Method
Stantec 2026 Results				
Made Ground (cohesive)	7	1 to 11	4.5 to 49.5	SPT – windowless sampler boreholes
	1	4	18	SPT – cable percussion
	1	-	92	Hand shear vane
Made Ground (granular)	3	0 to 2	-	SPT – windowless sampler boreholes
Upper Tunbridge Wells Sand (cohesive)	3	1 to 12	4.5 - 54	SPT – cable percussion
	8	5 to >50	22.5 to 225	SPT – windowless sampler boreholes
	5	-	62 to 98	Hand shear vane
	2	-	50 to 244	Laboratory triaxial test
	2	19 to 38	-	SPT – cable percussion (Peck et. al. (1967))



Ground Investigation Report

9 Geotechnical data

Stratum	No. of tests	SPT N ₆₀ (N-value) (range)	c _u (kPa)	Method
Upper Tunbridge Wells Sand (granular)	2	49 to >50	-	SPT – windowless sampler boreholes (Peck et. al. (1967)
Grinstead Clay Member (cohesive)	9	32 to >50	144 to 225	SPT – cable percussion
	30	0 to >50	0 to 225	SPT – windowless sampler boreholes
	12	-	50 to 117	Hand shear vane
Grinstead Clay Member (granular)	2	43 to >50	-	SPT – cable percussion



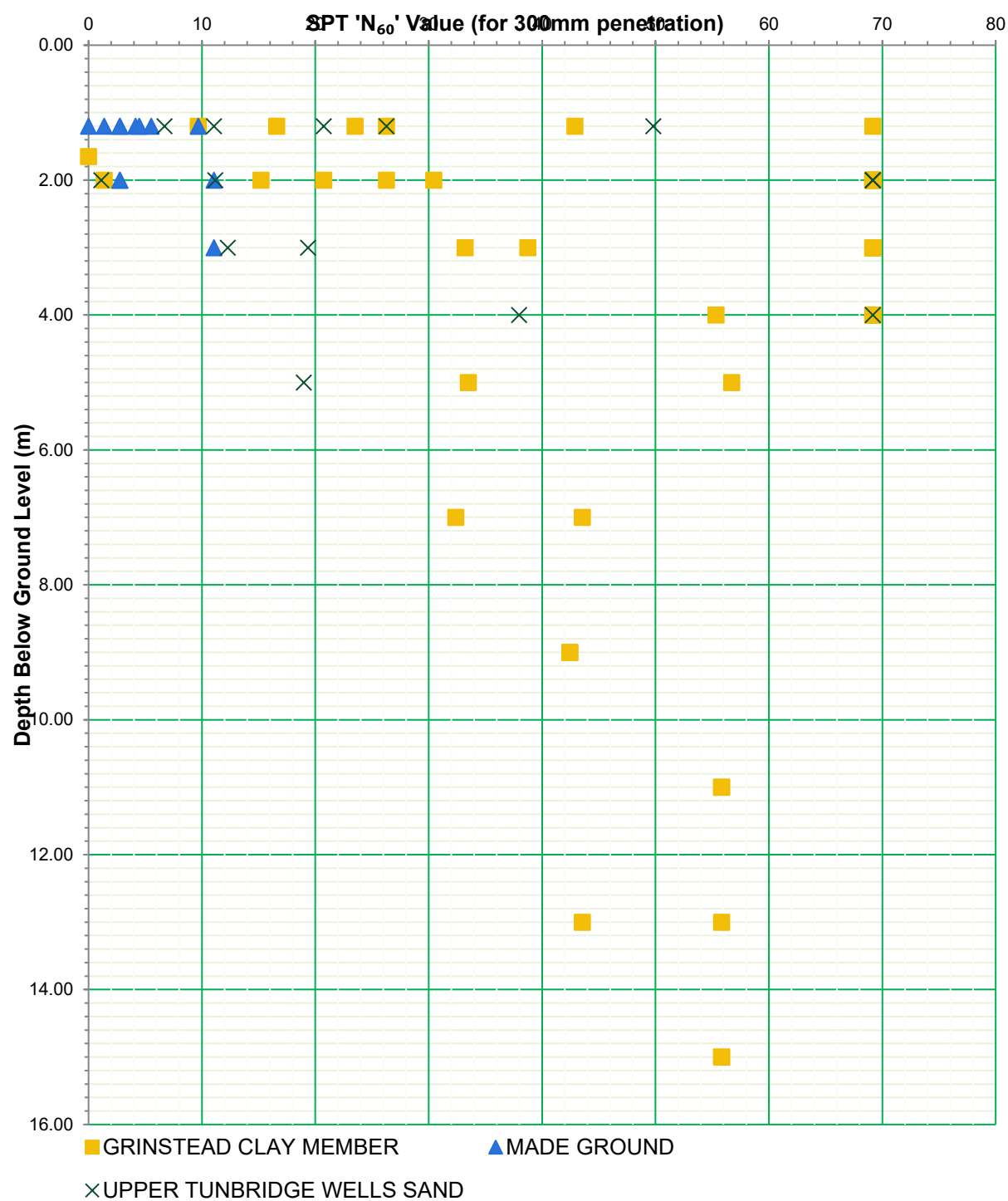


Figure 9-2: SPT N_{60} versus depth

9.6 Sulphate content

In accordance with BRE (Special Digest 1), pH and sulphate testing has been carried out on a selection of samples across the site. Table 9-5 summarises the results, which are presented in Appendix D. the Design Sulphate (DS) classification and the Aggressive Chemical Environment for Concrete (ACEC)



classification are presented in Section 10.6 and the assessment summary sheets are presented in Appendix C.

Table 9-5: Aggressive chemical environment concrete testing results

Stratum	No. tests	Water Soluble Sulphate (mg/l)	Total Potential Sulphate (%)	pH
Stantec 2026 Results				
Made Ground	5	23.9 to 105	0.069 to 0.171	5.8 to 7.4
Upper Tunbridge Wells Sand	5	19 to 1120	0.018 to 0.939	5.0 to 6.4
Grinstead Clay Member	10	10.8 to 799	0.015 to 2.076	5.1 to 8.8
Omnia 2023 Results				
Topsoil	2	410 to 720	-	7.4 to 7.8
Made Ground/Made Ground Waste	28	8.1 to 2100	-	5.5 to 8.2
Upper Tunbridge Wells Sand	5	1.5 to 17.5	-	5.4 to 7.2
Grinstead Clay Member	10	2.7 to 110	-	5.0 to 7.8

Based on the above results, the worst case DS and ACEC classes for the strata encountered on site is summarised in Table 9-6:

Table 9-6: Worst case design sulphate and aggressive chemical environment for concrete classification

Stratum	DS	ACEC
Made Ground	DS-3	AC-4
Upper Tunbridge Wells Sand	DS-3	AC-4
Grinstead Clay Member	DS-4	AC-5

The results for the Grinstead Clay Member includes two elevated Total Sulphur values that have raised the DS and AC classes. These two values are from 11.90m and 12.90m depth in CP401 and CP402 respectively. Due to the depth of the samples tested, it is only likely that the ground would be exposed in the event of piling and it is unlikely that the ground at this depth would remain exposed to the air for a long enough time period during pile construction for the potential sulphate to develop (through oxidation). As such, it is considered reasonable that the DS and AC classes for Grinstead Clay may be reduced to DS-2, AC-3.

9.7 Derived values of ground properties

In accordance with BS EN ISO 1997-1 (EC 7), Stantec considers the proposed structures would be classified as Category 2 structures. As part of the separate geotechnical design, the designer should determine the geotechnical design values.

Table 9-7 provides characteristic geotechnical values to assist the designer. These are based on laboratory testing, *in situ* testing and by professional judgement using published data together with



knowledge and experience of the ground conditions. The values are based on laboratory testing undertaken to date.

Care should be exercised in using these assumed soil strength parameters for any purpose beyond the scope of this report because it may be that additional sampling and testing are required for certain purposes. The reader should refer to the original test results summarised in Section 8 and provided in Appendix C.

Table 9-7: Characteristic geotechnical values

Stratum	Bulk unit weight kN/m ³	Effective angle of internal friction	Undrained shear strength	Effective cohesion
	γ^a	$\phi'^{b,d}$	c_u^c	c'
Made Ground	17	21	-	0
Upper Tunbridge Wells Sand	19	27	90	0
Grinstead Clay Member	19	24	140	0
a. Measured as part of the triaxial strength test and estimated based on the recommendations of BS 8004-2015. b. Internal friction (ϕ') values for the cohesive in-situ material derived from BS 8004-2015, where ϕ_{cv}' is derived from plasticity index. The use of ϕ_{cv}' in the analysis is considered to provide a conservative estimate of ϕ'. c. Site measurements and laboratory data. d. Made Ground parameters are based on engineering judgement				



10 Geotechnical assessment

10.1 Geotechnical categorisation of the proposed development

Eurocode 7, Section 2 advocates the use of geotechnical categorisation of the proposed structures to establish the design requirements.

The proposed development is to comprise low rise (1 to 2.5 storey) dwellings as part of a care village, with associated gardens, public open space and infrastructure. A preliminary review of the levels indicates up to 2.0m of cut and 4.0m of fill across the site. In addition, a review of the drainage strategy indicates surface water will be retained in an attenuation pond located in the west of the site.

Based on the above, for the purposes of this investigation, the proposed structures have been classed as Geotechnical Category 2.

For Category 2 structures, the Geotechnical Category should be re-assessed at the design stage and specific geotechnical design (in addition to this investigation), is required.

Following the ground investigation, and as part of the assessment provided in the following section, the preliminary geotechnical hazard identification undertaken in Section 5 has been updated. Assessment has been undertaken in accordance with the general requirements of ICE/DETR Document 'Managing Geotechnical Risk' and the HE documents HE-DMRB-G CS 641 and CD 622. The preliminary Geotechnical Risk Register following investigation is provided in Appendix G (Table G.2) and will need to be updated during future design works.

10.2 Groundwork

10.2.1 Site preparation

The site is previously undeveloped and whilst no significant buried obstructions were encountered by this investigation, the possibility of buried obstructions being encountered remains. Therefore, it is recommended that an allowance be made for breaking out obstructions, for example provision of pneumatic breakers for site plant.

Topsoil should be removed from beneath all building and hardstanding areas.

10.2.2 Groundworks

Following breaking out of hardstanding and obstructions, excavation of shallow soils should be readily undertaken by conventional plant and equipment. However, excavation through any buried construction may require heavy-duty excavation plant/ripping plant/blasting/the use of specialist breaking equipment.

Trial pit faces were noted to remain generally vertical without collapse. The faces of shallow, near vertically sided excavations put down at the site are likely to remain stable for short periods of time.

The Grinstead Clay Member was noted to be fissured and whilst instability due to fissuring was not noted in the short trial pit excavations, fissuring can cause instability of longer excavations.



Temporary trench support, or battering of excavation sides, is recommended for all excavations that are to be left open for any length of time and will definitely be required where man entry is required. Particular attention should be paid to excavation at, or close to, site boundaries/adjoining existing roads/structures/buildings, where collapse of excavation faces could have a disproportionate effect.

A risk assessment of the stability of any open excavation should be undertaken by a competent person and appropriate measures adopted to ensure safe working practise in and around open excavations. Further guidance on responsibilities and requirements for working near, and in, excavations can be obtained from the Construction Design and Management Regulations (2015); Construction Information Sheet 47: Inspections and Reports (2005) and HSG47: Avoiding Danger from Underground Services.

To ensure no loads are imposed on the sides of the excavation, spoil should not be placed immediately adjacent to the excavation. Spoil should be placed a suitable distance from the side of the excavation (as assessed by a competent person).

Based on site observations, the rate of water ingress to the proposed excavations is unlikely to be significant and may be adequately controlled by sump pumping. While only limited volumes of perched water was encountered within the Made Ground, there remains a possibility for larger volumes to be held locally within the Made Ground, particularly after period of significant rainfall. Larger quantities of water encountered at shallow depth may require alternative methods of dewatering, such as well points, or use of impermeable cut-offs should be allowed for.

It should be recognised that groundwater levels may vary from those at the time of the investigation, for example in response to seasonal fluctuations and the timing of construction may dictate the extent of groundwater control required.

Any water pumped from excavations may need to be passed via settlement tanks (to reduce suspended solids) before being discharged to the sewer. Discharge consents may also be required. In addition, due to petroleum hydrocarbons in the groundwater, any water pumped from excavations may need to pass via a treatment plant to reduce concentrations to acceptable limits.

10.2.3 Earthworks/reuse of site-won materials

It is understood that up to 2.0m of cut and 4.0m of fill is required as indicated on cut and fill drawing 26364-STN-00-ZZ-DR-C-7400-P06 presented in Appendix A.

Following the removal of topsoil, in the order of 41,605 m³ of fill and up to 3,655m³ of cut is necessary to form the development platform. Some of the excavated material will be suitable for re-use on site as engineered fill, subject to appropriate processing and confirmation testing.

The classification of fill material depends on both the proposed end use and whether the material will meet the performance requirements of that end use.

Review of geotechnical data (see Section 9 and Appendix C) coupled with Stantec's experience, indicates that:

- Following processing to remove oversized, contaminated and deleterious material the Made Ground may be suitable for reuse as general fill;
- The natural Upper Tunbridge Wells Sand and Grinstead Clay Member are likely to be suitable for reuse subject to specific confirmation testing;



- Where Made Ground is exposed by cutting it should be over-excavated and removed.

The earthworks may need to be undertaken under a Materials Management Plan (see Section 12).

Before the use of hydraulic binders is approved, comprehensive testing will need to be completed by a specialist Contractor to satisfy both themselves and the Engineer of the suitability of the soils for treatment and to confirm that the requisite end-performance of the material is achievable. In all instances where improvement by the inclusion of binders is considered, a mix design is required and as part of this design, samples should be checked for swelling, even where very low sulphate values are recorded.

Due to the significant earthworks required at the site it will be necessary to develop an appropriate Site-Specific Earthworks Specification. The basis for the Specification should be BS 6031:2009 and the latest version of the SHW, Series 600 Earthworks. Once site proposals have been further defined more specific consideration will need to be given to the reuse of materials.

10.2.4 Settlement

Made Ground from former operations is present across the majority of the site and it is understood that up to 2.0m of cut and 4.0m of fill is required. As the Made Ground decomposes the ground will naturally settle, which can lead to problems in new developments such as distorted falls to drainage and movement of the ground away from building entrances. Consideration should be given to the degree of settlement anticipated over the design life of the development such that remediation measures can be incorporated into the design.

Additionally, as land raising is required to facilitate the development, this additional load placed on the Made Ground will cause additional settlement to occur. Further geotechnical design will need to be considered to determine the impacts of consolidation settlement across the site.

10.3 Foundation recommendations

This section provides recommendations for the foundations for houses, garages and related buildings as indicated on the indicative site layout drawing KCP-PRP-ZZ-XX-DR-A-1010-P12 presented in Appendix A.

The recommendations in this report are based on the current NHBC Standards (2024).

In accordance with EC7, BS EN 1997-1+A1 (2013) the proposed structures are considered to be Geotechnical Category 2. Recommendations for Geotechnical Category 2 structures are presented to aid development proposals only. A separate geotechnical design will be required at the design stage.

Subject to detailed geotechnical design, the safe bearing pressures for foundations in this report take into consideration the risk of shear failure of the ground (ultimate limit state). However, they do not assess acceptable limits of settlement (serviceability limit state). Serviceability limit state assessment will need to be undertaken as part of the separate geotechnical design.



10.3.1 Site Zoning

On the basis of the ground conditions indicated from the current (and previous) investigations, the site is considered as two zones as follows:

- Zone A: Made Ground
- Zone B: Natural ground

The extent of these zones are illustrated on the Foundation Zonation Plan (Stantec Drawing 333701756-STN-XX-XX-DR-GE-0007-P01), which is provided in Appendix A.

In Zone A, Made Ground was encountered at shallow depth and extended to depths up to 3.50m bgl. The thickness of the Made Ground varied across the zone, with thinner deposits generally encountered towards the edges of the zones. Due to this variation in thickness, as well as the significant cut and fill required to form the development platforms, some areas within Zone A may have the full thickness excavated prior to construction, such that foundations would bear on to the underlying natural ground.

Similarly, where filling is required the Made Ground may be buried to an extent that renders the use of traditional foundations impractical. The below discussion considers several options for developing the site. The suitability of each technique for a particular plot will need to be considered in the context of the ground conditions encountered and the earthworks required in that location.

10.3.2 Ground Improvement

Much of the site is underlain by Made Ground, which presents a number of geotechnical hazards to the proposed development associated with the poor bearing characteristics and settlement of this material, as well as its lateral variability. Differential settlement of the Made Ground has the potential to cause undulations and cracking to hardstanding surfaces, create uneven falls to drainage runs and cause unacceptable displacements around structures supported on piles.

To mitigate the potential damage caused by settlement of the Made Ground, ground improvement techniques can be used to improve the characteristics of the ground. Possible ground improvement techniques to be considered for this development may include vibro stone columns, rigid inclusions and/or High Energy Impact Compaction (HEIC).

There are a number of ground improvement techniques that may be suitable; however, not all techniques are suitable for all sites. The main constraints for this site include the presence of Made Ground and the variability of the Made Ground composition, and the shallow groundwater held within the Made Ground. Contamination within the Made Ground is also a consideration when selecting a suitable ground improvement technique.

The advice of a specialist contractor should be sought to assist in the selection of a suitable ground improvement technique for the site and the design of the final ground improvement solution. Depending on the method selected it may be possible to use the improved ground to support low-rise buildings in addition to drainage and road elements.



10.3.3 Shallow Foundations

Surrounding the perimeter of the Made Ground, predominantly to the south and southwest, shallow foundations may be a suitable option. In these areas the Made Ground was thin enough for foundation excavations to reach the underlying natural ground, or were entirely absent.

Where foundation depths are stepped, for instance to match changes in ground conditions, topography or depths due to trees, the steps should be designed in accordance with the requirements of the NHBC Standards.

If trees are to be removed as part of the development the roots should be grubbed out and foundations extended to below the zone of disturbance created by this activity and to below any remaining root hairs.

In addition, deepening of foundations in accordance with NHBC Standards may be required where foundations are within the zone of influence of existing or removed trees, or where new trees and proposed shrub planting is located. A tree survey has been undertaken at the site by an arboriculturalist to identify the type and height of existing trees on site and including any off-site trees which may have an effect on foundation design. This has been completed to support the reserved matters submission. The tree survey has not yet been provided, however should be reviewed with respect to shallow foundations. Void formers may be required in these areas, in accordance with Chapter 4.2 of NHBC guidelines.

Foundation formations should be inspected by a geotechnical engineer or other suitably competent person to ensure the founding conditions are suitable and as indicated in this report. Any formation materials deemed as unsuitable should be excavated and replaced with lean mix concrete or deepened to suitable strata. If this is not possible, alternative solutions (such as piling) should be undertaken.

Foundation excavations should be protected from rainfall, inflow of surface water, frost and freezing conditions. They should also be protected from drying out in hot dry weather.

Groundwater monitoring indicates a shallow groundwater table and excavations may be difficult to undertake. Alternative methods of groundwater control may be required as fast groundwater ingress is anticipated, which could result in unstable excavations.

10.3.4 Piled Foundations

Where piled foundations are adopted, they should extend through the Made Ground to a suitable depth within either the Upper Tunbridge Wells Sand or Grinstead Clay Member.

Bored piles with the use of casing or CFA piles should be suitable to support the foundations for the structures. However, the choice of piling system should be undertaken by a specialist piling Contractor and the design of piles is beyond the scope of this report. The decision on pile type and design should take into account the following factors relevant to the site:

- Pile installation can create preferential pathways for the migration of contaminants to the groundwater.
- Boring of piles through coarse soils can result in loosening of the material, with resultant risk of shaft collapse prior to concreting and reduced shaft friction.



- Due to the presence of shallow groundwater, temporary casing may be required for bored piles. If CFA piles are used, concrete is placed as the auger is withdrawn, which can balance the water pressure if the operation is undertaken carefully.
- Deeper groundwater strikes within the Grinstead Clay Member suggest groundwater is present, held under sub-artesian pressure and is associated with sandstone layers within the clay. The presence of these deeper ground conditions must be taken into consideration during pile design and selection of piling methods and equipment.
- Piles should extend a minimum of five pile diameters into the natural stratum to mobilise sufficient shaft friction and end-bearing resistance to carry the required loads without unacceptable settlement.
- As the piles are to be constructed through compressible soils and have fill placed over them, piles should also be designed to cater for the potential down-drag effects of negative skin friction on piles from the secondary consolidation / creep of the recently placed Made Ground and fill.
- Where bored piles extend through very soft ground, bulging of the concrete can occur, leading to lateral pressure on adjacent piles.
- The effect of trees should be considered on the piles during design.

10.3.5 Foundation works risk assessment

A foundation risk assessment will be required to determine if the proposed piling will result in a significant increase in risk of pollution to controlled waters.

The foundation works risk assessment should be undertaken in accordance with the risk assessment flowchart from National Groundwater & Contaminated Land Centre Report NC/99/73 and will need to identify what additional risks to the environment piling may introduce and, if necessary, identify mitigation measures that will need to be put in place to remove any significant adverse environmental impacts.

10.3.6 Working platform

A working platform will be required prior to the arrival on site of tracked piling plant. This should be designed and installed in accordance with BR470 (BRE 2004) based on data on the specific plant in accordance with an FPS certificate for the rig loadings.

It should be noted that due to the poor ground conditions on site, the working platform when assessed in accordance with BR470 is expected to be of significant thickness. Additional assessment using proprietary methods or detailed geotechnical modelling (e.g. limit state assessment) may, with the addition of geogrids, reduce the working platform thickness.

10.4 Roads and pavements

To date, CBR testing has not been undertaken. It is considered likely an equilibrium CBR of >5% will be achievable over the majority of the site following completion of the significant earthworks required at the site. This will be subject to geotechnical testing during and on completion of the earthworks to confirm the CBR achieved.

Where cut and fill is not required, proof rolling of the formation level will be required and any loose or soft spots should be removed and replaced with an engineered fill, in accordance with a suitable



specification. The formation level will need to be protected during inclement weather from deterioration; all slopes should be trimmed to falls to shed rain water and the surface sealed to limit infiltration.

Where the CBR is found to be less than 2.5%, the sub-grade may be unsuitable for both the trafficking of site plant and as support for a permanent foundation, without improvement works being undertaken. Improvement works should be carried out in accordance with DMRB IAN 73/06 Rev 1 Chapter 5. In summary, consideration may be given to the following potential remedial techniques:

- excavation and re-engineering or replacement of weaker soils;
- the inclusion of geosynthetic reinforcement within the unbound layers of the capping and sub-grade;
- where cohesive soils are present and they are deemed suitable for treatment with hydraulic binders, to employ modification and/or stabilisation techniques on the formation; and
- where granular soils are present, de-watering and re-engineering the formation.

10.5 Drainage

Soakaway testing has not been undertaken at the site due to the site being a Made Ground. It is considered that soakaway drainage will be unsuitable at the site due to the predominantly clay bedrock geology present on site.

Due to the presence of Made Ground across most of the site it is likely that additional measures such as piles or ground improvement, will be required to support manhole chambers and heavier drainage elements to maintain long term stability and minimise differential settlement between drainage elements.

Full drainage design at the site would require consideration of the potential to mobilise contaminants within the Made Ground. Drainage design is outside of the scope of this report.

10.6 Buried concrete

Based on guidelines provided in BRE Special Digest 1 (BRE 2005) and the information presented in Section 9, the site overall can be classified as follows:

- Design Sulphate Class DS-3.
- Aggressive Chemical Environment for Concrete Class AC-4.

This equates to a Design Chemical Class of DC-4.



11 Geo-environmental assessment

11.1 Objectives

The objectives of the geo-environmental assessment presented in the following sections are to:

- undertake a generic quantitative risk assessment in accordance with LCRM using published generic assessment criteria.
- screen out contaminant linkages that don't potentially pose an unacceptable risk to defined receptors.
- identify whether the ground conditions are suitable for the proposed land use from a land contamination perspective.
- identify contaminant linkages that potentially pose an elevated risk or are associated with a level of uncertainty that warrants further consideration.

11.2 Updated conceptual site model

The initial CSM developed from the desk study and field reconnaissance survey has been updated using the findings of the ground investigation. This updated CSM is the basis for the geo-environmental assessment presented in this section.

Following the ground investigation, the plausible contaminant sources, receptors and pathways identified in the preliminary geo-environmental risk assessment (Section 4) have been updated or confirmed as follows.

11.2.1.1 Sources

The ground investigation has confirmed the presence of the following sources identified in the initial CSM:

No potential sources have been removed from, or added to, the model.

11.2.1.2 Receptors

The ground investigation has confirmed the presence of the following receptors identified in the initial CSM:

No potential receptors have been removed from, or added to, the model.

11.2.1.3 Pathways

The ground investigation has confirmed the presence of the following pathways identified in the initial CSM:

No potential pathways have been removed from, or added to, the model.



11.3 Risk assessment approach

Using the updated CSM, a Stage 1 Tier 2 generic quantitative risk assessment (GQRA) for identified receptors based on all media sampled has been undertaken in accordance with the principles of LCRM.

Firstly, the risks associated with the identified potential contaminant linkages have been estimated using standardised methods (typically involving comparison of site data with published 'screening values'). Secondly, where screening values are exceeded, the result has been evaluated in an authoritative review of the findings with other pertinent information to determine whether or not the exceedance is or is not acceptable in the site-specific circumstances.

The data sets used in the assessment comprise the analytical results obtained by Stantec as listed in Section 4 together with any reliable data from previous investigations as listed in Section 0.

In cases where potentially unacceptable risks are indicated and/or the land is potentially unsuitable for its intended use, actions such as more advanced stages of risk assessment (Tier 3, detailed quantitative risk assessment (DQRA)) or remediation are proposed in Section 14.

11.4 Data Sets

The data set(s) used in this report is based on the conceptual site model and the proposed development, and is taken to be the entire area of the site, with the data separated into topsoil, Made Ground, and natural soils.

GAC based on a soil organic matter (SOM) of 6% and 1% have been adopted for the Made Ground and natural soils respectively, based on the laboratory results summarised in Section 8.

11.5 Human health risk assessment

11.5.1 Generic Assessment Criteria

The soil screening values used are Generic Assessment Criteria (GAC) (i.e. derived in accordance with EA CLEA guidance (2009) using the updated exposure model detailed in Defra SP1010 (2014), with the exception of published C4SLs. The term 'GAC' used in this report is inclusive of all generic soil screening values.

Based on the proposed development, generic assessment criteria (GAC) based on a default residential without homegrown produce CLEA land use scenarios have been adopted.

GAC are selected based on the following hierarchy:

- Category 4 Screening Levels (C4SL), where available.
- SoBRA Acute GAC for free cyanide, as acute dose toxicity is the primary risk driver.
- Stantec GAC, derived by Stantec as detailed in Appendix E.

The potential risks to human health arising from the presence of volatile contaminants in groundwater have been assessed in accordance with the SoBRA GW GAC guidance (2024). This is a preliminary



approach whereby GAC have been developed using the CLEA v1.071 model for indoor air and outdoor inhalation pathways only, assuming a residential or commercial end-use.

Exclusion screening distances for assessing vapour intrusion risk are also considered as an additional line of evidence where appropriate. Human health risk from the consumption of potable water (if relevant) is addressed by the Controlled Waters Risk Assessment with the adoption of drinking water guidelines and standards as the assessment criteria (see Section 11).

11.5.2 Assessment results

Soil and groundwater data assessment sheets are presented in Appendix E. As an initial screen, all soil samples have been compared to the GAC irrespective of depth. It is recognised that depth is a relevant consideration when evaluating the plausibility of exposure, and this is considered in the evaluation of the outcome of the GAC screening.

11.5.3 Risk evaluation

The screening exercise has identified exceedances of asbestos, arsenic, lead, benzo(b)fluoranthene and dibenz(a,h)anthracene from the Made Ground in the Stantec 2026 results. Elevated concentrations of arsenic, beryllium and lead in the Made Ground and arsenic, beryllium, lead, nickel, cyanide (free), benzo(a)pyrene, benzo(b)fluoranthene and dibenz(ah)fluoranthene in the Made Ground, and arsenic and beryllium in the natural soils in the Omnia 2023 ground investigation works. There were no exceedances identified in the topsoil samples (from the Omnia or Stantec investigation) or within the natural geology samples from the Stantec 2026 samples. These are considered further here to assess if the exceedance may be acceptable with respect to the proposed development. The phrase 'further assessment' does not necessarily mean that the soil is 'contaminated' or not fit for use.

11.5.3.1 Made Ground

There are two exceedances of arsenic in the Made Ground from the Stantec 2026 GI, and three exceedances from the Omnia 2023 GI, with a maximum reported concentration of 150mg/kg versus a GAC of 40mg/kg. The exceedances are generally located in the central to eastern area of the site.

There are four exceedances of beryllium in the Omnia data within the Made Ground, with a maximum concentration of 5.1 compared to the GAC of 1.7mg/kg. The exceedances are generally located in the central to eastern area of the site. Beryllium is not included in the major British Geological Survey (BGS) and UK Soil Observatory (UKSO) soil datasets. It is reported in other publications as follows, based on more limited datasets. The reported range of beryllium concentrations in UK soils is 0.47-6.21mg/kg with a mean of 2.22 mg/kg and an average of 2.7 mg/kg according to two references quoted by the Environment Agency in their review of the UK Soil and Herbage Survey data¹. The BGS notes in its report exploring the data available for the derivation of normal background concentrations in the UK² that beryllium is naturally associated with granitic and alkaline intrusive rocks and is enriched in micaceous material and secondary minerals weathered from alkaline rocks (such as chalk). Elevated concentrations are also associated with coal deposits and atmospheric deposition from coal combustion.

It is therefore common for natural concentrations of beryllium to exceed the residential GAC of 1.7mg/kg. In addition, no visual or olfactory indicators of contamination was recorded during the ground



investigation works. Based on the above, the marginal exceedances and the absence of visual and olfactory indicators of contamination, the risk to future site users is considered to be low.

Lead is also present in the Made Ground in both the Stantec 2026 and Omnia 2023 data, with a total of four exceedances of the GAC. A maximum concentration of 1,100mg/kg was recorded against the GAC of 310mg/kg. The exceedances were recorded within the east of the site, furthermore the majority of exceedances identified are greater than 1m bgl. It is understood that the site is going to be raised by up to 3-4m in areas, therefore given the depth of the exceedances and the raised levels of the site, the exceedances are not considered a significant risk to human health and no further consideration is required. This is the same for one minor nickel exceedance (200mg/kg versus a GAC of 180mg/kg) at TP312 at 1.2m bgl.

Elevated concentrations of free cyanide have been recorded in two locations in the Omnia 2023 data. Both exceedances are recorded at 1m bgl, with a maximum concentration of 1,287.2mg/kg against the GAC of 24mg/kg. Given the depth of these exceedances and the proposed fill at these locations, the exceedances are not considered a significant risk to human health and no further consideration is required.

Within the Made Ground in TP316, TP317, TP412 and TP416 there are exceedances of benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene and dibenzo(ah)anthracene. The exceedances are concentrated within the southeastern portion of the site at depths primarily at 1m bgl. Should site levels be lowered in this area, consideration should be given to the placement of clean cover in this area, where Made Gound is present at formation level.

Asbestos has been positively identified within two samples from the 2026 Stantec investigation. Quantification testing has confirmed 0.002% of loose chrysotile fibres in TP403 at 0.40m bgl and 0.012% chrysotile sheet/board debris in WS410 at 0.50m bgl. The presence of asbestos cannot be discounted across the remainder of the site.

The above exceedances should be reviewed against the final cut/fill levels. Where Made Ground remains at formation level, additional remedial measures may be required. The presence of hardstanding / building footprints will mitigate the identified risks.

11.6 Controlled Waters Risk Assessment

11.6.1 Generic Assessment Criteria

The risks to groundwater and surface water from contaminants on site have been assessed in accordance with the Environment Agency (2006) Remedial Targets Methodology (RTM) Levels 1-2. In doing so the compliance point for the assessment is set as the groundwater directly beneath the site on a precautionary basis.

Site contaminant concentrations are compared with relevant screening values (Water Quality Targets (WQTs), which are linked to the CSM.

Acceptable WQT are defined for protection of human health (based on Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)). In this instance, site concentrations have been compared against EQS on the basis that:



- The site is underlain by the Upper Tunbridge Wells Sand Formation which is classified as a Secondary A aquifer, the Grinstead Clay member which is classified as unproductive strata, and infilled ground which is unclassified, and the site is not located in a source protection zone.
- The nearest surface water feature is a pond located 20m south of the site.

The values adopted are detailed in and the use of these values in this assessment is considered as a first screening for potential risks of pollution of Controlled Waters. More detailed assessment may be required, with this identified in Section 14.

There are no UK drinking water WQT for petroleum hydrocarbon fractions in water. The Water Supply Regulations 1989 and the Private Water Supply Regulations 1991 both contained a prescribed concentration of 10 µg/l for 'dissolved or emulsified hydrocarbons (after extraction with petroleum ether); mineral oils'. This was removed when these Regulations were updated in 2000 and 2009 respectively. However, 10 µg/l is used in this report as an initial screening assessment noting that any exceedance has no direct regulatory significance.

11.6.2 Assessment results

Groundwater data assessment sheets are presented in Appendix E. Based on the data comparison against the WTV the results indicate that the chemicals of potential concern (CoPC) require further assessment are: zinc, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, fluoranthene and EPH >C16-C35 in the Omnia 2023 soil leachate samples; Nickel in the historical Made Ground water samples; and Nickel and Zinc in the historical natural geology groundwater samples. The groundwater sampling undertaken as part of the Stantec 2026 investigation recorded elevated concentrations of ammoniacal nitrogen, chloride, sulphate, cobalt, copper, manganese, nickel, zinc, benzo(b)fluoranthene and fluoranthene in samples taken from the Grinstead Clay.

11.6.3 Risk evaluation

Within the Omnia 2023 soil leachate data, there are exceedances of the EQS for zinc, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, fluoranthene and EPH >C16-C35.

There is only one exceedance for zinc in the Omnia 2023 soil leachate samples (30ug/l compared to a WQT of 10.9 ug/l). There is also only one exceedance for zinc in the Omnia and Stantec groundwater samples within the natural geology, and none within the Made Ground leachate samples. Additionally, there are no exceedances of Nickel in the Omnia soil leachate samples, and only one exceedance in the Made Ground water samples and two exceedances within the natural groundwater samples (max. 37ug/lg versus a WQT of 4ug/l). These exceedances are considered not to represent a significant risk of pollution to controlled waters from an on-site source.

The Stantec 2026 groundwater samples have also recorded elevated concentrations of cobalt, copper, and manganese in groundwater samples taken from the Grinstead Clay. The manganese was recorded to be significantly elevated (2,800ug/l) in borehole CP401 (EQS of 123ug/l). The elevated concentrations of ammoniacal nitrogen, chloride and sulfate were also recorded in the sample taken from borehole CP402 from groundwater within the Grinstead Clay.

The Omnia soil leachate data also show exceedances of the EQS for PAHs benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, fluoranthene, and petroleum



hydrocarbons EPH >C16-C35. These are located throughout the Made Ground, however concentrations within the Made Ground leachate and natural geology groundwater samples were generally below detection with no exceedances of the WQT, although elevated concentrations of benzo(b)fluoranthene and fluoranthene were recorded in the groundwater samples taken from the natural strata in the Stantec investigation. The CoPC recorded within the soil leachate and groundwater samples are similar to those identified within the Made Ground, indicating that the overlying Made Ground is the likely source of contamination. Earthworks are proposed as part of the development enabling works and where not suitable, Made Ground will be removed from site. In some areas, up to 3m of fill is proposed which will limit the infiltration of surface water and further mobilisation of contaminants. This is further support by the presence of proposed building footprints and hardstanding. Although elevated concentrations of contaminants have been recorded in the soil leachate and groundwater samples, it would be disproportionately costly to excavate and remove all of the Made Ground from the groundwater.

To date, surface water samples from the adjacent ponds to the west have not been taken. It is recommended that this is undertaken. The results of which should be used to inform the requirement for further detailed risk assessment.

11.7 Ground gas risk assessment

The potential risk from ground gas has been assessed in accordance with BS 8485:2015+A1:2019 and has been based on the relevant data identified and summarised in Section 8.

11.7.1 Assessment Criteria

Gas monitoring has been undertaken at the site on the basis of the historical ground investigation data and preliminary risk assessment. The assessment guidelines set out in Table 2 of BS 8485 are based on interpretation of the gas concentrations and the gas flow rates. The quantitative assessment has been carried out by comparing the individual gas concentrations and gas screening values (GSV) within Appendix C with the published characteristic situation (CS) thresholds, in addition to worst-case GSV assessment in accordance with Section 6.3.7 of BS8485.

The range of ground gas concentrations and their computed gas screen values are assessed as per BS8485:2015+A1:2019 to determine the appropriate Characteristic Situation for the site. Characteristic Situation GSV criteria is summarised below.

Table 11-1: Characteristic Situation as per BS8485:2015+A1:2019

Characteristic Situation (CS)	Hazard Potential	GSV value
CS1	Very low	<0.07
CS2	Low	0.07 - 0.7
CS3	Moderate	0.7 - <3.5
CS4	Moderate to high	3.5 - <15
CS5	High	15 - <70
CS6	Very high	>70



11.7.2 Data adequacy

As per BS8576:2013 Decision Matrix for Initial Monitoring, it is judged from the available evidence that the gas generation potential at the site is high to very high as the site is a Made Ground, and as per Tables 5.5a and 5.5b CIRIA C665, the sensitivity of the development is high as it is a proposed care development. Consequently, and in accordance with CIRIA C665 (Table 5.5a and 5.5b) and Figure 6 BS8576:2013, an appropriate minimum monitoring regime is 6 visits on a fortnightly basis provided other monitoring requirements are also met, such as prevailing atmospheric pressure conditions (for example, BS 8485:2015 +A1:2019 suggests monitoring should include a period of falling atmospheric pressure).

Stantec has undertaken four visits to date, alongside a previous monitoring regime of three visits.

11.7.3 Assessment results

The risks associated with the ground gases methane (CH₄) and carbon dioxide (CO₂) have been assessed using BS 8485:2015 +A1:2019.

The assessment guidelines set out in Table 2 of BS 8485 are based on interpretation of the gas concentrations and the gas flow rates. The quantitative assessment has been carried out by comparing the individual gas concentrations and borehole hazardous gas flow rate values (Q_{hg}) in Appendix C with the published CS thresholds (BS 8485 Table 2), in addition to a worst-case GSV assessment in accordance with section 6.3.7 of BS 8485. The assessment is summarised and presented in full in Appendix C.

11.7.4 Risk evaluation

Ground gas risk assessment did not form part of the scope of works of the Omnia 2023 historical ground investigation report used throughout this report. Ground gas monitoring was undertaken as part of the Harrison Environmental Group ground investigation, which it is understood that the client does not have reliance upon. Conclusions of this ground gas risk assessment were Characteristic Situation 2 conditions at the site. However, it should be noted that there was no flow within any of the boreholes during monitoring, and based on the groundwater level monitoring completed after installation it is likely that the response zones were flooded and as such are not considered to be representative of the true ground gas conditions at the site.

To date, four rounds of gas monitoring have been undertaken with a further two rounds to be undertaken within the Stantec 2026 boreholes. The calculated borehole hazardous gas flow rates for carbon dioxide and methane indicates CS1 conditions and methane and carbon dioxide at concentrations are 'typically' below 1% and 5% respectively. As such, the site is provisionally classified as Characteristic Situation 1. This report will be updated upon completion of the monitoring.

Based on the data to date, subject to confirmation with the LPA and the warranty provider, no mitigation measures are required.

11.8 Phytotoxicity risk assessment

Soil contaminants, if present at sufficient concentrations, can have an adverse effect on plant health. Phytotoxic effects can be manifested by a variety of responses, such as growth inhibition, interference



with plant processes, contaminant-induced nutrient deficiencies and chlorosis (yellowing of leaves). Phytotoxicity is a difficult parameter to quantify given that experimental techniques vary widely and variations exist in plant tolerances, soil effects and synergistic/antagonistic reactions between chemicals. Guidelines for phytotoxicity and general plant health have been published for a limited number of substances for topsoil (BS BS3882:2015), for soils used for grazing/landscaping (ICRCL 70/90), and for agricultural uses (MAFF Code of Good Agricultural Practice). Some of these guidelines focus on reduced yield for agricultural crops, and in general do not define concentrations in soil at which plant health is necessarily significantly compromised. The guidelines are not based on plant uptake and human consumption considerations, this is considered as an exposure route in the derivation of human health GAC.

Reported soil sample results have been screened against these guidelines (where available) and the results are provided in the screening tables in Appendix E.

Based on individual test results that exceed the phytotoxic GAC, CoPC which require further assessment are Boron, Copper, Nickel and Zinc. However, the majority of these exceedances are at depths greater than 0.5m bgl. Cut/fill is proposed across the site which will raise site levels in some area. Where Made Ground remains at formation level, it is not considered to be a suitable growing medium, and therefore clean cover will be required. Construction materials risk assessment

11.8.1 Water Pipelines

A formal water pipe investigation and risk assessment is beyond the scope of this report. However, the findings of this investigation have been compared to the threshold values in Water UK HBF (2014), Table 1 as far as is practicable.

The site is brownfield and organic contamination (petroleum hydrocarbons) has been identified in exceedance of the threshold values and Stantec believes barrier pipe is required. However, confirmation should be sought from the water supply company at the earliest opportunity.

Because the requirements from individual water companies can vary, confirmation of pipeline requirements should be sought from the relevant water supply company at the earliest opportunity.

11.8.2 Other construction materials

Plastic pipes for drains and sewers are manufactured from unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) or polyethylene (PE). These materials may be affected by the presence of organic compounds in the soil.

In accordance with the British Plastics Federation Guidance (August, 2018), elevated concentrations of hydrocarbons and Volatile Organic Compounds have been recorded, the pipework manufacturer should be consulted with regard the suitability of the pipework.

The implications for buried concrete are discussed in Section 10.



11.9 Contamination risk to construction workers

Whilst risks to construction workers are not discussed in detail, the following section discusses potential risks that should be considered in the preparation of Risk Assessments, Method Statements, Plans of Work, or equivalent.

Information presented is provided to assist in managing the risk associated with contamination in soil and groundwater at the site but is not definitive. Contractors are responsible for undertaking their own assessments and assessing what risks are present and what control measures are required.

Task specific risk assessments and method statements should be in place, and risks and required mitigation measures communicated to all relevant personnel prior to the works commencing. Appropriate PPE and, if required, RPE should be provided and utilised.

11.9.1 Metals, metalloids, PAH and petroleum hydrocarbons

The Made Ground contains elevated concentrations of metals and metalloids throughout.

11.9.2 Ground gas

It is noted that concentrations of carbon dioxide (an asphyxiant) in the soil exceed HSE Workplace Exposure Limits for personnel in the working environment of 1.5% for short term (15 minutes) exposure and 0.5% for long term exposure. Furthermore, soil concentrations of oxygen are below the HSE recommendations of 18%.

Soil gas concentrations are not necessarily reflected by those in the breathing zone, as such, all Contractors and maintenance workers should be made aware of the possible presence of carbon dioxide and should take all necessary health and safety precautions when working in trenches or confined spaces.

11.9.3 Vapours

There were no significantly elevated PID readings from within the soil samples. However, strong hydrocarbon odours were noted throughout the ground investigation and there is a risk of volatilisation from the soils and groundwater, especially in confined spaces and risk assessments and method statements should be in place if vapours and odours are identified during excavation. Additional guidance can be found in EH40/2005 Workplace Exposure Limits (HSE 2011).

11.9.4 Asbestos

Visible fragments of potential ACM was recorded within TP403 (0.002%) and WS410 (0.012%) in the soils in the form of loose fibrous debris and sheeting/board debris, respectively.

As the ACM and asbestos fibres have been contained in the soil for many years, the likelihood is that they would be degraded to some extent. Given the material is 'clearly identifiable' and 'original form' it is likely that the works being undertaken would be considered licensed work and should be considered so until proven otherwise.



All site staff should be made aware that there is a likelihood of encountering further asbestos containing materials within the Made Ground anywhere on the site, and at any stage of the development. It is advised that the Contractor should supply suitable and sufficient 'Asbestos Awareness' training (specific to asbestos in soils) to all site staff who could foreseeably encounter asbestos containing materials during the course of their work.

The Contractor must manage the risks in accordance with their legal requirements and will need to prepare appropriate health and safety documentation and obtain appropriate approvals, licences, consents and permits prior to commencement.

It is the responsibility of the Contractor to ensure that methods used and mitigation measures applied are suitable and sufficient to prevent exposure to airborne asbestos so far as is reasonably practicable in accordance with Regulation 11 of CAR2012.

11.10 Consideration of Climate Change

Climate change has the potential to change the risk profile for conceptual site models and associated contaminant linkages. The impact of climate change on the CSM is site-specific, and a qualitative assessment of the potential impact of climate change on the CSM for this site is summarised below. The assessment has primarily utilised the guidance in Environment Agency (2010) and SoBRA (2022) which set out the UK context to climate change and land contamination. Both guidance documents advocate a "what if" scenario approach in the context of changes in ambient temperatures, an increase in the frequency of extreme rainfall/storm events and heatwaves/droughts, and long-term changes in groundwater and sea levels.

Those "what if" scenarios that are relevant to this CSM are:

- Increased long-term rainfall leading to increased infiltration and seasonally higher groundwater and water levels in surface waters.
- Increased frequency and/or magnitude of extreme rainfall events leading to short-term surface flooding, surface water run-off, groundwater flooding, and/or land-based erosion.
- Increased frequency and/or magnitude of storm events leading to short-term drops in barometric pressure and/or high winds.
- Occurrence of extreme cold and hot weather events leading to changes in ground conditions such as soil temperature, evapo(trans)piration, and soil moisture (for example freeze-thaw effects and desiccation), decreased infiltration and fall in groundwater and surface water levels.
- Long-term decrease in rainfall leading to lower infiltration and fall in groundwater and surface water levels.

In considering the potential impact of climate change, the following factors have been considered:

- The current depth to groundwater is 2.6m bgl.
- The underlying geology at the site are unlikely to be physically adversely affected by desiccation, subsidence or erosion.
- The UK Climate Predictions published by the Met Office indicate that over the lifetime of the proposed development average:
 - Precipitation is forecast to decrease by 8% by 2075;
 - Temperature is forecast to increase by 4 degrees by 2075;



- Groundwater recharge is forecast to decrease by <5%.
- Potential changes in soil moisture levels and soil temperature are not likely to have a significant impact on contaminant fate and transport (mobility and degradation) noting that a rise in soil temperature will likely increase the volatility and solubility of contaminants and increase the microbial degradation of contaminants. A reduction in soil moisture may decrease microbial degradation and increase vapour and gas diffusion.

No foreseeable impacts of climate change on the CSM have been identified.

For further details on the considerations made, refer to Table I. in Appendix I.

11.11 Updated Conceptual Site Model

The potential sources, pathways and receptors identified in the desk study (Section 8) have been investigated and assessed. The Source-Pathway-Receptor linkage assessment originally developed as the desk study stage has been updated on the basis of the investigation information and generic risk assessment and is presented in Appendix H.

The final CSM is illustrated in Figure 11-1.

A summary of the Source-Pathway-Receptor (S-P-R) contaminant linkages for which the risks may be unacceptable and require mitigation (those that are moderate or higher) are identified in Table 11-2 below.

Table 11-2 assumes the S-P-R linkages which have been discounted (subject to agreement) at the risk evaluation stage are confirmed by the regulators and the warranty provider as not requiring further consideration (mitigation). If these assumptions are not agreed during regulatory discussions, the conclusions will need to be updated.

The S-P-R linkages that warrant further assessment and/or mitigation are:

Table 11-2: Updated plausible contaminant linkages

Source	Pathway	Receptor
Made Grounded possibly containing elevated concentrations of petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), metals, metalloids, asbestos, and Asbestos Containing Materials (ACMs) (S01)	Ingestion, skin contact, inhalation of dust and outdoor air by people (P01)	Site users. (R01)
	Root uptake by plants (P03).	Buildings on site (R02)
	Leaching through unsaturated zone (P04)	Groundwater and possible abstractors. (R03)
	Surface run-off. (P06)	Aquatic ecosystems. (R04)
	Base flow from contaminated groundwater (P05)	Plant life (R05).



Source	Pathway	Receptor
Organic materials in the Made Ground producing ground gases (carbon dioxide and methane) and vapours (S02)	Methane ingress via permeable soils and/or construction gaps (P02)	Site users. (R01) Buildings on site (R02) Neighbours. (R01)

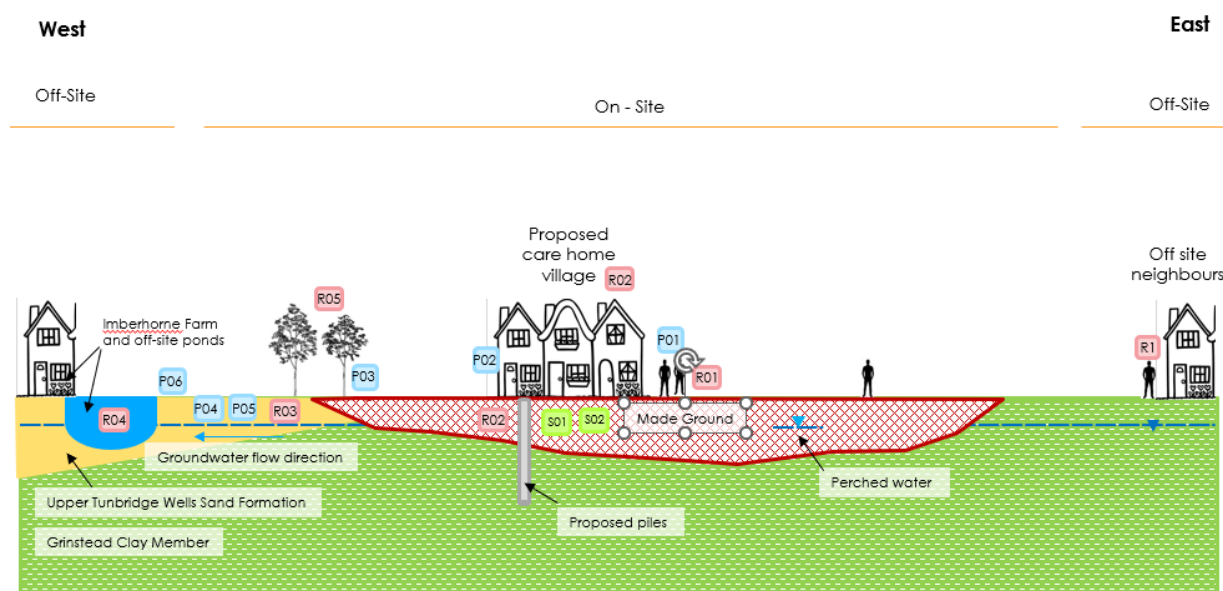


Figure 11-1. Illustrative Conceptual Site Model

11.12 Preliminary mitigation measures

11.12.1 Summary

The outline remediation strategy presented below is provided for guidance only, and does not represent a 'Remediation Options Appraisal', or a 'Remediation Strategy', prepared in accordance with LCRM.

Subject to regulatory and NHBC agreement, Stantec consider the following mitigation is required to demonstrate the site is suitable for use for the proposed end use. These mitigation works will likely be undertaken in a number of phases (although could be undertaken by the same Contractor) and can be separated into:

- Enablement Phase; and
- Construction Phase.

There will also be a requirement to undertake works to ensure the site is geotechnically suitable (and where relevant, these stages are summarised below to assist planning of the works).

The methodology for the remediation should be presented in a Remediation Strategy (which will include the 'Implementation Plan', the 'Verification Plan' and the 'Long Term Monitoring and Maintenance



Plan'), which will need to be submitted to the warranty provider and the regulatory authorities for approval.

The writing and approval of a Materials Management Plan will be required to allow reuse of the minimal volumes of suitable uncontaminated, naturally occurring soils present at the site. In addition, as excavation of existing waste soils is required, an appropriate Environmental Permit will also be required to manage and control the works. This will require discussion and agreement with the Environment Agency, and at this stage, it is anticipated the permit will comprise a Standard Rule No. 27, although this is subject to Environment Agency agreement.

Verification reports by a suitably qualified independent geo-environmental specialist will be required following completion of any remedial works (including ground gas membrane installation).

11.12.2 Enablement phase

It is anticipated that the Enablement Phase of works would be undertaken by a specialist remediation Contractor, and the following works are considered necessary during Enablement:

- Excavation and disposal of the existing topsoil (due to the requirement to raise site levels and the inability to re-use the Made Ground soils (due to waste regulations).
- Excavation of the Made Ground and natural soils as required to leave the site at the formation level required for construction or to allow filling.
- Ground improvement as necessary.
- Installation of deep drainage, services and service ducts, to include:
 - » Over-excavation of and backfill with suitable soil (clean imported granular material).
 - » Installation of plastic pipes above the groundwater table; or
 - » Installation of clay ware or concrete pipes / manholes where installed below the groundwater table.
- Removal of any free phase hydrocarbons encountered and disposal (none encountered to date).
- Import of subsoil in accordance with a MMP to allow filling to formation level.
- Placement of fill as per the Earthworks Specification to leave the site at the Formation Level to allow construction.
- Disposal of all excavated historical Made Ground soils (due to waste regulations) and management (in accordance with an Enablement Phase Material Management Plan (MMP) of any excavated natural uncontaminated soils.
- verification during enablement works.

Due to the potential for low concentrations of dissolved phase petroleum hydrocarbons in the groundwater, treatment of any water pumped from excavations (via a granulated activated carbon plant) may be required prior to discharge from the site. This would apply to both the enablement and construction phase of works.



11.12.3 Construction phase

Prior to commencement of the Construction Phase, it is anticipated that Enablement Phase works will have been completed to leave the site at a formation level to allow construction works, and the Construction Phase of works will comprise:

- Appropriate materials handling in accordance with a Construction Phase MMP (re-use of the imported uncontaminated natural soils used as fill during the Enablement Phase).
- Installation of barrier pipework (subject to agreement with the water authority).
- Over-excavation of shallow service trenches and backfill of plastic drainage pipes (above the groundwater table) with suitable soil (clean imported granular material).
- Potential installation of ground gas mitigation measures, subject to completion of the required monitoring.
- Import of aggregate (either recycled under the Quality Protocol, or quarried products), and use as part of road and pavement construction and temporary works (working platforms).
- Import of subsoil and topsoil in accordance with the Construction Phase MMP.
- The installation of an engineered cover system in gardens and public open space, likely to comprise:
 - » a high visibility bonded geogrid (factory bonded geogrid and nonwoven geotextile) to act as a marker / separator / hard to dig layer; and
 - » 450mm of Subsoil and/or Topsoil (minimum 150mm Topsoil) in public open space; or
 - » 600mm of Subsoil and/or Topsoil (minimum 150mm Topsoil) in gardens.
 - » Deepening will be required for tree pits.
- Installation of barrier pipework for water supplies.
- Disposal of all excavated historical Made Ground soils that had to be excavated during construction (due to waste regulations).

The methodology for the remediation should be set out in a Remediation Strategy (which will include the 'Implementation Plan', the 'Verification Plan' and the 'Long Term Monitoring and Maintenance Plan'), which will need to be submitted to the warranty provider and the regulatory authorities for approval.

In addition, the production of a Materials Management Plan and its approval by a Qualified Person may be required to allow reuse of suitable material at the site in accordance with waste regulations.

Verification reports by a competent independent geo-environmental specialist will be required following completion of any remedial works (including ground gas membrane installation).



12 Waste and materials management

12.1 Introduction

The Waste Framework Directive (WFD) (2009/98/EC) defines waste as ‘any substance which the holder discards or intends to discard.’ In a geo-environmental context, the waste is most often ‘soil’ and the two main scenarios are offsite disposal of the material as a waste and/or reuse of the material on site. For cost and sustainability reasons, reuse is preferred to off-site disposal.

Section 12.2 below describes the key issues relating to off-site disposal to Made Ground and Section 12.3 considers requirements relating to reuse of soils and materials management.

12.2 Waste disposal

12.2.1 Principles

Based on the WFD, any material excavated on site may be classified as waste and it is the responsibility of the producer of a material to determine whether or not it is waste. Where off-site disposal is undertaken, the following guidance applies.

Classification is a staged process:

- A hazardous waste is defined under the WFD as one which possesses one or more of fifteen defined hazardous properties. If a waste is not defined as hazardous, then it is non-hazardous.
- Where the materials are soil, it is then be assigned using the ‘List of Waste Codes’, which classifies the material as either:
 - hazardous (17-05-03), which is defined as “soil and stones containing hazardous substances”; or
 - non-hazardous (17-05-04), which is defined as “soil and stones other than those mentioned in 17-05-03”.
 - Stantec uses the proprietary assessment tool, HazWasteOnline™ to undertake this assessment.
- Waste Acceptance Criteria (WAC) testing is then undertaken if required, and are only applicable following classification of the waste, and only where the waste is destined for disposal to Made Ground. The WAC are both qualitative and quantitative. The WAC and the associated laboratory analyses (leaching tests) are not suitable for use in the determination of whether a waste is hazardous or non-hazardous.

It should be noted that some non-hazardous wastes may be suitable for disposal at an inert Made Ground as non-hazardous waste, subject to meeting the appropriate waste acceptance criteria.

It should be noted that classification must be undertaken on the waste produced, by the waste producer. Necessary sampling frequency to adequately characterise a soil population is defined within WM3. The Waste Acceptance Criteria testing undertaken as part of this ground investigation is to assist with setting budgets. Additional testing and assessment are required by the waste producer at the time of disposal, and the assessments presented in this report are indicative.



12.2.2 HazWasteOnline™ assessment

As the site is brownfield, in order to inform the preliminary waste characterisation process, Stantec has undertaken an exercise using the proprietary web-based tool HazWasteOnline™. The output of the HazWasteOnline™ assessment is provided in Appendix F and a summary of the preliminary waste classification is provided below.

12.2.3 WAC testing

The site is brownfield and the quantitative WAC tests are provided in Appendix E. A summary of the preliminary waste disposal options is provided below.

12.2.4 Preliminary waste disposal options

The site is brownfield and based on the site history, the HazWasteOnline™ assessment and the WAC testing, if suitable segregation of different types of waste is put in place, for soils to be disposed of, it is considered that:

- The topsoil generally has a low organic content (as proven by the Loss on Ignition and Total Organic Carbon tests) and is likely to be classified as non-hazardous waste.
- The natural uncontaminated subsoils are likely to be classified as non-hazardous waste and based on the WAC testing should be able to be disposed of at an 'inert' Made Ground.
- Any soils containing >0.1% asbestos or visible asbestos containing materials are considered hazardous. Hand picking of all visible asbestos should be conducted across site to reduce disposal classification and rates.

12.2.5 General waste comments

It should be noted that the preliminary waste assessment presented above is subject to the following:

- Any soils containing > 0.1% asbestos or visible asbestos containing materials would be considered as hazardous.
- It is the waste producer's responsibility to segregate the waste at source and waste producers must not mix waste materials/streams or dilute hazardous components, for example by mixing with less or non-hazardous waste on site to meet WAC limit values.
- The above preliminary assessment has been made on the basis of the soils tested as part of the ground investigation, using the HazWasteOnline™ assessment and WAC testing results. However, the formal classification of waste can only be undertaken on the material to be disposed of, and by the waste producer and the receiving Made Ground as license conditions vary from Made Ground to Made Ground.
- Basic Characterisation should be undertaken in accordance with Environment Agency guidance by the waste producer. Stantec can assist if required and this report will assist the characterisation. However, Basic Characterisation does not form part of the current commission and would require further assessment and testing on the wastes actually to be disposed.
- Once the waste producer has undertaken an initial Basic Characterisation on each waste stream, they can manage the soils as part of the on-site processing programme (for example, stockpiling, treatment, screening and separation). The waste producer and Made Ground



operator will then need to agree the suite of compliance testing for regularly generated waste to demonstrate compliance with the initial Basic Characterisation prior to disposal.

- At the time of disposal, additional testing on the excavated soils to be disposed of, will likely be necessary.
- Non-hazardous and hazardous soils require pre-treatment (separation, sorting and screening) prior to disposal.
- The costs for disposal of non-hazardous and hazardous soils are significant compared to disposal of inert material.
- In addition to disposal costs, Made Ground tax will be applicable. Non-hazardous and hazardous waste will generally be subject to the Standard Rate Made Ground Tax. Inert or inactive waste will generally be subject to the Lower Rate Made Ground Tax. The Made Ground tax value changes each April and can be found at <https://www.gov.uk/government/publications/rates-and-allowances-Made-Ground-tax/Made-Ground-tax-rates-from-1-april-2013>.
- Before a waste producer can move waste to a Made Ground site for disposal, they need to check the Made Ground site has the appropriate permit and must have completed the following:
 - Duty of care transfer note / Hazardous Waste consignment note, including comment as to if pre-treatment has been undertaken; and
- Basic Characterisation of the waste, to include: description of the waste; waste code (using list of wastes); composition of the waste (by testing, if necessary) and; WAC testing (if required).

12.3 Materials management

12.3.1 Introduction

Excavation and earthworks fill will be required to form the development platforms, the proposed buildings, drainage features and associated infrastructure.

The soils present on site are a mixture of: clean naturally occurring uncontaminated soil present around the periphery of the site, and historical waste (topsoil cover and Made Ground materials) within the central area.

Whilst re-use of soils is the preferred option, and the Made Ground soils are suitable for use below the proposed cover system; and there is a need for the volume of soils proposed to be excavated to be re-used on site, in accordance with current waste management regulations, any soils that are currently a waste, cannot be re-used if they are excavated (unless they undergo recovery).

Whilst it is possible to progress the waste recovery route, to re-use and “recover” excavated Made Ground soils at the site, this would involve:

- preparation of a Waste Recovery Plan and submission to the Environment Agency that they agree that the works would constitute “recovery” (for which there is no guarantees); followed by
- If successful, a Contractor would then need to apply for a Deposit for Recovery Permit.

Consultation with the EA should be undertaken at an early stage to confirm obligations and constraints in relation to development of the former Made Ground.



There is an element of uncertainty and significant timescales associated with the above route, in which case the following may be an additional option:

- All topsoil excavated to allow cut and fill earthworks is to be disposed of, off site to a licenced waste management facility.
- All Made Ground soils (currently a waste), excavated to allow cut and fill earthwork are to be disposed of, off-site to a licenced waste management facility.
- Naturally occurring, uncontaminated soils that are excavated as part of construction and proven suitable for use, are to be re-used at the site (likely used during the Enablement Phase works), and will need to be used in accordance with a Qualified Person declared MMP.
- If there is a requirement to lift levels in parts of the site, and it is intended to import soils to undertake these works. Import will need to be undertaken in accordance with a MMP.
- All Made Ground soils (currently a waste), excavated during construction (e.g. drainage and service trenches, foundations, etc), are to be disposed of, off-site to a licenced waste management facility.
- Any soils imported under a MMP to lift levels, can if they are re-excavated during later stages of works, be re-used on site (in accordance with an updated MMP (Construction Stage MMP)).

The regulatory regime for waste and materials management will need to be agreed with the regulators. However, at this stage, it is envisaged the works would be managed by the following processes:

- Excavation, stockpiling and processing of historical Made Ground soils (topsoil and Made Ground) in accordance with an Environmental Permit (SR2008 No 27: mobile plant for treatment of soils and contaminated material, substances or products).
- Excavation and re-use, and import of clean, naturally occurring materials under a Materials Management Plan prepared in accordance with 'The Definition of Waste: Development Industry Code of Practice', Version 2 (CL:AIRE), known as the DoWCoP.

It should be noted that Version 3 of the DoWCoP is undergoing preliminary consultation, and recommendations within this report with regard to waste and re-use of soils will require review when the DoWCoP Version 3 is adopted.

The reuse of soils at the site will require careful design, along with detailed discussions and agreement with the regulators on which regulatory framework applies to the various soils present at the site. The type of permit is subject to discussions with the regulators, and Stantec recommend early Contractor engagement to assist with permitting discussions and agreements.

Once all material movements have been completed a verification report must be produced and provided to the regulators. Once all material movements have been completed in accordance with the MMP a verification report must be produced, kept for 2 years and provided to the EA on request.

If soils are excavated and reused on sites (or moved to another site) without an agreed strategy (MMP, exemption, or appropriate Permit in place, anyone who knowingly facilitates the disposal may be 'jointly and severally liable' to any assessment of tax, fines or prosecution.





treated at.

12.3.1.1 Recycled materials

All recycled materials (6F2 etc.) must be produced under the 2013 WRAP 'Quality Protocol: Aggregates from inert waste', whether on site or off-site. If they are not, they will be deemed a waste and can only be used on site under a permit. More information can be found at <https://www.gov.uk/government/publications/quality-protocol-production-of-aggregates-from-inert-waste>.

12.3.1.2 Geotechnical improvement requirements

Construction activities carried out on uncontaminated soils solely for the purpose of improving geotechnical properties e.g. lime / cement modification, are not generally regarded as waste treatment operations and do not require a permit.

However, should processing be needed (such as screening, treatment or improvement), that would constitute a waste activity and require a mobile treatment permit. This may be as simple as removing oversize material with an excavator bucket, to using a riddle bucket to remove hardcore to full mechanical screening.



13 Uncertainties and limitations

13.1 Site-specific comments

The gas monitoring undertaken to date and included in this report is insufficient to fully characterise the site in accordance with BS 8485. Monitoring is ongoing and the conclusions of this report will be updated following completion of the scheduled monitoring.

13.2 General comments

Stantec UK Limited (Stantec) has prepared this report in accordance with the instructions of client. (the Client), by e-mail dated 10th April 2026 under the terms of appointment for Stantec, for the sole and specific use of the Client and parties commissioned by them to undertake work where reliance is placed on this report. Any third parties who use the information contained herein do so at their own risk. Stantec shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared or for use of the report by any parties not defined in Stantec's appointment.

This report details the findings of work carried out in 18th and 26th May 2026. The report has been prepared by Stantec on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, not all potential environmental constraints or liabilities associated with the site may have been revealed.

Stantec has used reasonable skill, care and diligence in the design of the investigation of the site and in its interpretation of the information obtained. The inherent variation of ground conditions allows only definition of the actual conditions at the locations and depths of trial pits and boreholes at the time of the investigation. At intermediate locations, conditions can only be inferred.

Groundwater data are only representative of the dates on which they were obtained and both levels and quality may vary.

Unless otherwise stated, the recommendations in this report assume that ground levels will remain as existing. If there is to be any re-profiling (e.g. to create development platforms or for flood alleviation) then the recommendations may not apply.

Information provided by third parties has been used in good faith and is taken at face value; however, Stantec cannot guarantee its accuracy or completeness.

Where the existing report(s) prepared by others have been provided by the Client, it is assumed that these have been either commissioned by the Client, or can be assigned to the Client, and can be relied upon by Stantec. Should this not be the case Stantec should be informed immediately as additional work may be required. Stantec is not responsible for any factual errors or omissions in the supplied data, or for the opinions and recommendations of others. It is possible that the conditions described may have since changed through natural processes or later activities.

The work has been carried out in general accordance with recognised best practice. Unless otherwise stated, no assessment has been made for the presence of radioactive substances or unexploded ordnance. Where the phrase 'suitable for use' is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Stantec.



The chemical analyses reported were scheduled for the purposes of risk assessment with respect to human health, plant life and controlled waters as discussed in the report. Whilst the results may be useful in applying the Hazardous Waste Assessment Methodology given in Environment Agency Technical Guidance WM3, they are not primarily intended for that purpose and additional analysis will be required at the time of disposal to fully classify waste. Discussion and comment with regards to waste classification are preliminary and do not form the requirements of 'Basic Characterisation' as required.

Assessment and testing for the presence of coal tar (where completed) has only been completed at the locations of exploratory holes undertaken for risk assessment purposes. This investigation is not designed to provide a definitive assessment of the risk from coal tar, nor the waste classification for bituminous bound pavement arisings at the site.

Unless otherwise stated, at the time of this investigation the future routes of water supply pipes had not been established. This investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling and chemical testing may be required at a later date once the routes of the supply pipes are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

Whilst the preliminary risk assessment process has identified potential risks to construction workers, consideration of occupational health and safety issues is beyond the scope of this report.

Please note that notwithstanding any site observations concerning the presence or otherwise of archaeological sites, asbestos-containing materials or invasive weeds, this report does not constitute a formal survey of these potential constraints and specialist advice should be sought.

Any site boundary line depicted on plans does not imply legal ownership of land.



14 Recommendations for further work

- Completion and reporting of the ongoing gas and groundwater monitoring, hence the conclusions in this report are provisional, subject to the completion of monitoring;
- Surface water sampling from the off-site pond.
- Discussion and agreement with utility providers regarding the materials suitable for pipework;
- Discussions with regulatory bodies and the warranty provider regarding the conclusions of this report;
- Completion of a Detailed Quantitative Risk Assessment, if required.
- Preparation of a Geotechnical Design Report.
- Preparation of an Earthworks Specification.
- Preparation of a Remediation Strategy and Verification Plan.
- Discussions with regulatory bodies and the warranty provider regarding the conclusions of this and future reports.
- Production of a Materials Management Plan and Environmental Permit.
- Enablement works, Contractor validation, and associated verification.
- Construction Phase mitigation works Contractor validation, and associated verification.
- Upon completion of monitoring regimes, site investigation boreholes should be decommissioned in line with relevant guidance where deemed appropriate by a qualified professional (for example the Environment Agency's Good Practice for Decommissioning Redundant Boreholes and Wells, 2012 or section 2.4.3.2 of NHBC NF94, 2023).



15 References

ASSOCIATION OF GROUND INVESTIGATION SPECIALISTS. 2006. Guidelines for Good Practice in Site Investigation. Issue 2. AGS, Beckenham.

ASSOCIATION OF GROUND INVESTIGATION SPECIALISTS. 2019. Waste Classification for Soils – A Practitioners' Guide. AGS, Beckenham.

BRE. 1980. Low-rise buildings on shrinkable clay soils: Part 1. BRE Digest 240. Building Research Establishment, Garston.

BRE. 1999. The influence of trees on house foundations in clay soils. BRE Digest 298. Building Research Establishment, Garston.

BRE. 2016. Soakaway design. BRE DG 365. BRE, Garston.

BRE. 2000. Specifying Vibro Stone Columns. BR391. BRE, Garston.

BRE. 2004. Working platforms for tracked plant: good practice guide to the design, installation, maintenance and repair of ground-supported working platforms. BR470. BRE, Garston.

BRE. 2005. Concrete in aggressive ground. BRE Special Digest 1, 3rd Edition. BRE, Garston.

BRITISH PLASTIC FEDERATION. August 2018. 'Designing Drains and Sewers for Brownfield Sites. Guidance Notes'. BPF Pipes Group (<https://www.bfppipesgroup.com/media/29155/Designing-drains-and-sewers-for-brownfield-sites.pdf>)

BRITISH STANDARDS INSTITUTION. 2003. Geotechnical investigation and testing - Identification and classification of rock - Part 1: Identification and description. BS EN ISO 14689-1 Incorporating Corrigendum No.1. BSI, London

BRITISH STANDARDS INSTITUTION. 2004+A1 2013. Eurocode 7 – Geotechnical design - Part 1: General rules. BS EN 1997-1+A1. Incorporating Corrigendum February 2009. BSI, London.

BRITISH STANDARDS INSTITUTION. 2007. Eurocode 7 – Geotechnical design - Part 2: Geotechnical investigation and testing. BS EN 1997-2. BSI, London.

BRITISH STANDARDS INSTITUTION. 2010. Code of practice for earthworks. BS 6031 Incorporating Corrigendum No.1:2010. BSI, London.

BRITISH STANDARDS INSTITUTION. 2026. Code of Practice for Investigation of Potentially Contaminated sites. BS 10175. BSI, London.

BRITISH STANDARDS INSTITUTION. 2012. Trees in relation to design, demolition and construction – Recommendations. BS 5837. BSI, London.

BRITISH STANDARDS INSTITUTION. 2012. Geotechnical investigation and testing — Geohydraulic testing Part 2: Water permeability tests in a borehole using open systems BS EN ISO 22282-2. BSI, London.

BRITISH STANDARDS INSTITUTION. 2013. Guidance on investigations for ground gas. Permanent gases and Volatile Organic Compounds (VOCs) BS 8576. BSI, London.



BRITISH STANDARDS INSTITUTION. 2015+A1:2020. Code of Practice for Foundations. BS 8004. BSI, London.

BRITISH STANDARDS INSTITUTION. 2015. Specification for topsoil. BS 3882. BSI, London.

BRITISH STANDARDS INSTITUTION. 2013. Specification for subsoil and requirements for use. BS8601. BSI, London.

BRITISH STANDARDS INSTITUTION. 2020. Code of practice for ground investigations. BS 5930+A1 2020, BSI, London.

BRITISH STANDARDS INSTITUTION. 2019. Concrete – complementary British Standard to BS EN p206-1 – Part 1: Method of specifying and guidance to the specifier. BS 8500-1+A2 2019. BSI, London.

BRITISH STANDARDS INSTITUTION. 2019. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. BS 8485:2015 +A1:2019. BSI, London.

BRITISH STANDARDS INSTITUTION. 2020. Soil Quality – Conceptual Site Models for potentially contaminated sites. BS EN ISO 21365:2020

BRITISH STANDARDS INSTITUTION. 2021. Soil and waste – Guidance on the selection and application of screening methods. BS EN ISO 12404:2021

CARD, G., LUCAS, J., WILSON, S., 2019. Risk and reliability in gas protection design - 20 years on. Ground Engineering, August/September 2019.

CL:AIRE. 2011. The Definition of Waste: Development Industry Code of Practice, Version 2. Contaminated Land: Applications in the Real Environment (CL:AIRE), London.

CL:AIRE, 2017. A Pragmatic Approach to Ground Gas Risk Assessment. Research Bulletin 17, CL:AIRE, Buckinghamshire. ISSN 2047-6450.

CL:AIRE. 2016. CAR-SOIL™ Control of Asbestos Regulations 2012 - Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry guidance. Contaminated Land: Applications in the Real Environment (CL:AIRE), London.

CL:AIRE, 2018. Ground gas monitoring and 'worst-case' conditions. Technical Bulletin 17, CL:AIRE, Buckinghamshire, August 2018.

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

CL:AIRE, 2021. Good practice for risk assessment for coal mine gas emissions. CL:AIRE, Buckinghamshire. ISBN 978-1-905046-39-3

CL:AIRE, 2022. Resilience and Adaptation for Sustainable Remediation, SuRF-UK bulletin SuRF 5, August 2022.

CLAYTON, C. R. I. 2001. Managing Geotechnical Risk. Improving productivity in UK building and construction. Thomas Telford, London.



CONCRETE SOCIETY, THE. 2013. Concrete industrial ground floors. A guide to design and construction. Technical Report 34 (4th Ed.). The Concrete Society, Camberley.

DEPARTMENT FOR ENVIRONMENT FOOD AND RURAL AFFAIRS (DEFRA). 2005. 'Made Ground (England and Wales) (Amendment) Regulations', (with reference to previous iterations of the regulations).

DEFRA. 2014. SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document. Defra, London.

ENVIRONMENT AGENCY. June 2001. National Groundwater and Contaminated Land Centre Report NC/99/73: Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. The Environment Agency, Bristol.

ENVIRONMENT AGENCY, 2008. An ecological risk assessment framework for contaminants in soil. Science report SC070009/SR1. The Environment Agency, Bristol.

ENVIRONMENT AGENCY. 2006. Remedial Targets Methodology. Hydrogeological Risk Assessment for Land Contamination. The Environment Agency, Bristol.

ENVIRONMENT AGENCY, 2010. Guiding Principles for Land Contamination. Part 2. FAQs, technical information, detailed advice and references, March 2010.

ENVIRONMENT AGENCY. November 2010. Guidance on waste acceptance procedures and criteria. Waste acceptance at Made Grounds. The Environment Agency.

ENVIRONMENT AGENCY. November 2010. Environment Agency Regulator Position Statement 075 (EARPS075). The Environment Agency.

ENVIRONMENT AGENCY. November 2011. Treatment of waste for Made Ground. Report – GEHO1111BVDF-E-E 913_11, Version 2 The Environment Agency.

ENVIRONMENT AGENCY. 2021. Waste classification. Guidance on the classification and assessment of waste (1st Edition v1.2.GB) Technical Guidance WM3. The Environment Agency.

ENVIRONMENT AGENCY. 2023. Land Contamination: Risk Management (LCRM). The Environment Agency.

HATANAKA, M, UCHIDA, A, KAKURAI, M, and AOKI, M. 1980. A consideration on the relationship between SPT N-value and internal friction angle of sandy soils. Journal of Structural and Construction Engineering (Transactions of AIJ). 63. 125-129. 10.3130/aijs.63.125_2.

HEALTH and SAFETY EXECUTIVE. December 2005. Construction Information Sheet 47: Inspections and Reports (CIS 47 (Rev 1)). HSE.

HEALTH and SAFETY EXECUTIVE. 2014. HSG47 - Avoiding danger from underground services (Third edition). HSE.

HEALTH and SAFETY EXECUTIVE. January 2020. EH40/2005 Workplace Exposure Limits (4th edition 2020,). HSE.



HIGHWAYS AGENCY. 2009. Design Guidance for Road Pavement Foundations (Draft HD25). Interim Advice Note 73/06. Rev 1. Highway Agency, London.

HIGHWAYS AGENCY. 2014. Manual of Contract Documents for Highway Works, Specification for Highway Works: Volume 1, Amendment August 2014. Highway Agency, London.

THE HIGHWAYS AGENCY. 2000. Design Manual, Road and Bridges: CS 641 - Managing the maintenance of highway geotechnical assets. CS 641 Rev 0. Highway Agency, London.

THE HIGHWAYS AGENCY. 2019. Design Manual for Roads and Bridges. Managing Geotechnical Risk. CD 622 Rev 0. Highway Agency, London.

JOHNSON, R. 2001. Protective measures for housing on gas contaminated land. Building Research Establishment Report BR 414. BRE, Garston.

JONES, H. K., MORRIS, B. L., CHENEY, C. S., BREWERTON, L. J., MERRIN, P. D., LEWIS, M. A., MACDONALD, A. M., COLEBY, L. M., TALBOT, J. C., MCKENZIE, A. A., BIRD, M. J., CUNNINGHAM, J. and ROBINSON, V. K. 2000. The physical properties of minor aquifers in England and Wales. British Geological Survey Technical Report WD/00/04. 234pp. Environment Agency R and D Publication 68.

LORD, J.A., CLAYTON, C.R.I. and MORTIMORE, R.N. 2002. Engineering in Chalk. CIRIA Report C574. Contaminated Land: Applications in Real Environments, London.

McDOWELL, P.W, COULTON, J., EDMONDS, C.N. AND POULSOM, A.J. 'The nature, formation and engineering significance of sinkholes related to dissolution of chalk in SE Hampshire, England', Quarterly Journal of Engineering Geology and Hydrogeology 2008, v.41, p279-290.

MALLETT, H., COX, L., WILSON, S., and CORBAN, M. 2014. Good practice on the testing and verification of protection systems for buildings against hazardous ground gases. CIRIA Report C735. Contaminated Land: Applications in Real Environments, London.

UK HEALTH SECURITY AGENCY (UKHSA) and BRITISH GEOLOGICAL SURVEY. December 2022. Indicative Atlas of Radon Potential for Great Britain (Version 3) ()

MINISTRY OF HOUSING, COMMUNITIES and LOCAL GOVERNMENT. 22nd July 2019. Land affected by contamination. Planning Policy Guidance Reference ID: 33-001-20190722.

MINISTRY OF HOUSING, COMMUNITIES and LOCAL GOVERNMENT (MHCLG). Internet published Planning practice guidance <https://www.gov.uk/government/collections/planning-practice-guidance>. MHCLG. London

MINISTRY OF HOUSING, COMMUNITIES and LOCAL GOVERNMENT. December 2023. National Planning Policy Framework.

NATHANAIL P., JONES A., OGDEN, R., AND ROBERTSON A. 2014. Asbestos in soil and made ground: a guide to understanding and managing risks. CIRIA Report C733 Contaminated Land: Applications in Real Environments, London.

NHBC and ENVIRONMENT AGENCY. 2008. Guidance for the safe development of housing on land affected by contamination. R&D Publication 66, 2 Volumes.

NHBC. 2024. NHBC Standards. NHBC, Milton Keynes. <https://nhbc-standards.co.uk/>



NHBC FOUNDATION. 2023. Hazardous ground gas - an essential guide for housebuilders. NF94. NHBC, Milton Keynes

PARRY, D. and CHIVERRELL, C. (eds). 2019. Abandoned Mine Workings Manual. CIRIA Report C758D. CIRIA, London.

PECK, R.B., HANSON, W.E., AND THORNBURN, T.H., Foundation Engineering, 2nd Edn, John Wiley, New York, 1967, p.310.

RAWLINS, B. G., McGRATH, S. P., SCHEIB, A. J., CAVE, N., LISTER, T. R., INGHAM, M., GOWING, C. and CARTER, S. 2012. The advanced geochemical atlas of England and Wales. British Geological Survey, Keyworth.

SCIVYER, C. and JAGGS M. 2023. Radon: Guidance on protective measures for new buildings. Building Research Establishment Report BR 211 6th Edition. BRE, Garston.

SHAND, P., EDMUNDS, W.M., LAWRENCE, A.R., SMEDLEY, PAULINE, BURKE, S. 2007. The natural (baseline) quality of groundwater in England and Wales. Environment Agency, 72pp. (RR/07/006)

SoBRA, 2014. Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health from Volatile Contaminants in Groundwater. 90pp. Version 2.0.

SoBRA, 2022. Guidance on Assessing Risk to Controlled Waters from UK Land Contamination Under Conditions of Future Climate Change, Society of Brownfield Risk Assessment, August 2022.

SoBRA, 2023. The Climate Emergency: Practical Considerations in Brownfield Risk Assessment. Summer Workshop 2022 Report. Version 1.1, June 2023

STONE, K., MURRAY, A., COOKE, S., FORAN, J. and GOODERHAM, L. 2009. Unexploded ordnance (UXO), a guide to the construction industry. CIRIA Report C681. Contaminated Land: Applications in Real Environments, London.

STROUD, M. A. 1975. The standard penetration test in insensitive clays and soft rocks. Proceedings of the European Symposium on penetration testing, 2, 367-375.

TOMLINSON. M.J. 2001. Foundation Design and Construction (6th Edition and 7th Edition). Prentice Hall Press

WASTE AND RESOURCES ACTION PROGRAMME (WRAP). October 2013. Quality Protocol. Aggregates from inert waste. End of waste criteria for the production of aggregates from inert waste.

WATER UK HBF. January 2014. Contaminated Land Assessment Guidance. Water UK and the Home Builders Federation.

WFD-UKTAG. July 2014. UKTAG River and Lake Assessment Method, Specific Pollutants (Metals), Metal Bioavailability Assessment Tool (M-BAT). Water Framework Directive – United Kingdom Technical Advisory Group. Stirling.

WILSON, S., OLIVER, S., MALLETT, H., HUTCHINGS, H. and CARD, G. 2007. Assessing risks posed by hazardous ground gases to buildings. CIRIA Report C665. Contaminated Land: Applications in Real Environments, London.



WILSON S., ABBOT S., MALLET H. 2014. Guidance on the use of plastic membranes as VOC vapour barriers. CIRIA Report C748 Contaminated Land: Applications in Real Environments, London.

WILSON, S., COLLINS, F. and LAVERY, R., G. 30th July 2018. Using ternary plots for interpretation of ground gas monitoring results. Ground Gas Information Sheet No 1 Paper 1.0. Ambisense Limited and EPG Limited.

WILSON, S. and MORTIMER, S., 2017. Piled foundations and pathways for ground gas migration, Environmental Geotechnics, ICE Publishing.

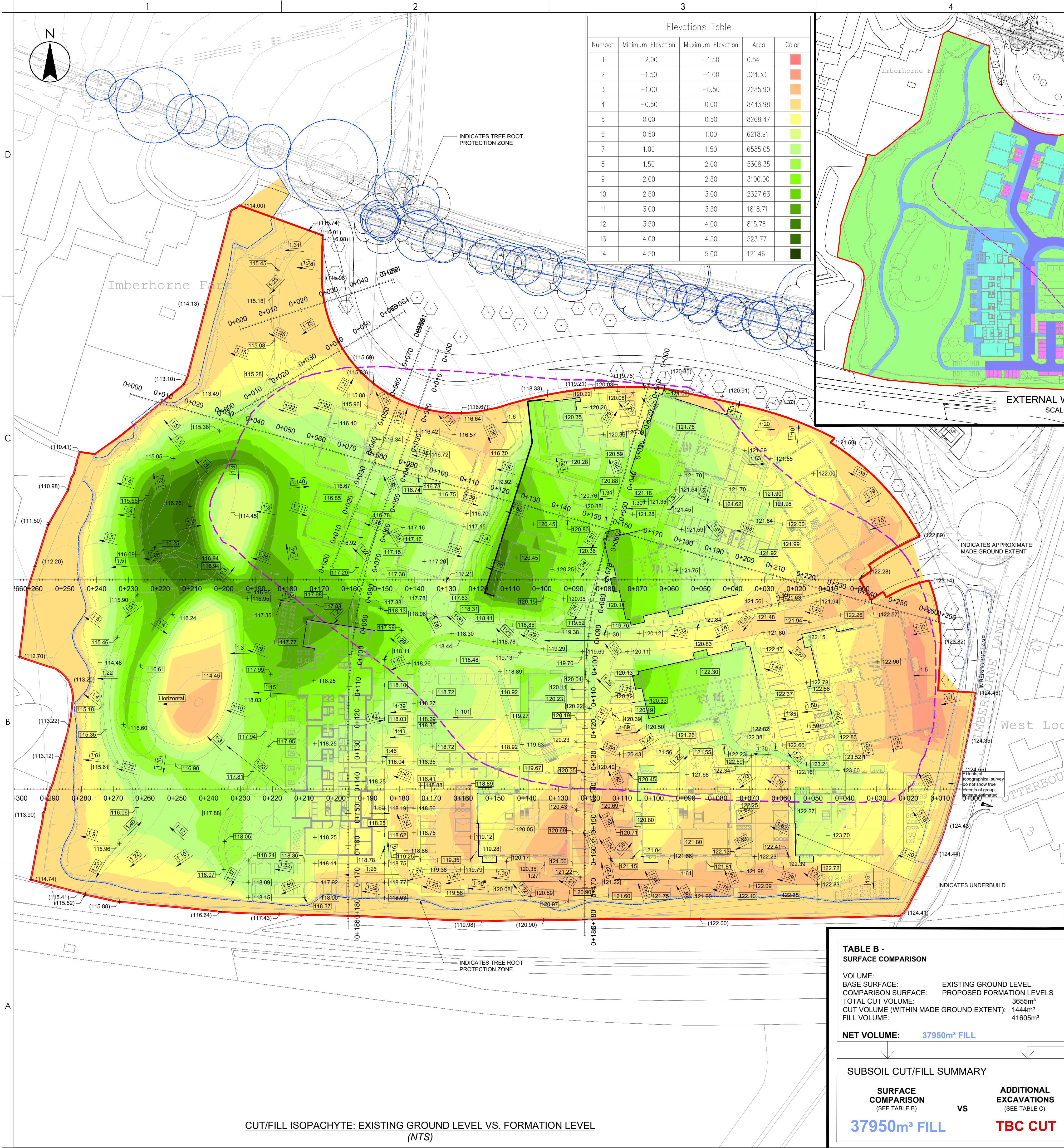


Appendices

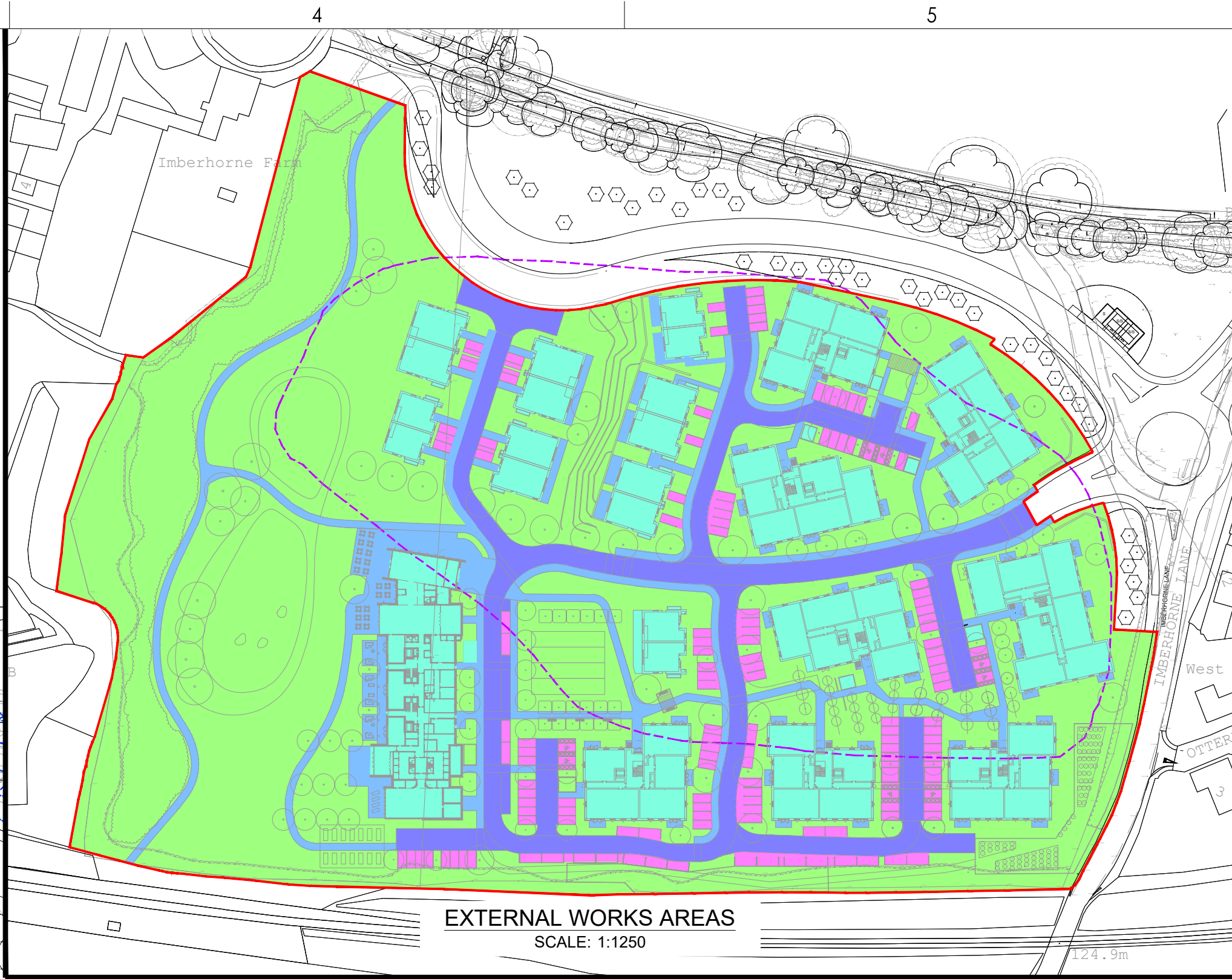


Appendix A Drawings





Elevations Table				
Number	Minimum Elevation	Maximum Elevation	Area	Color
1	-2.00	-1.50	0.54	
2	-1.50	-1.00	324.33	
3	-1.00	-0.50	2285.90	
4	-0.50	0.00	8443.98	
5	0.00	0.50	8268.47	
6	0.50	1.00	6218.91	
7	1.00	1.50	6585.05	
8	1.50	2.00	5308.35	
9	2.00	2.50	3100.00	
10	2.50	3.00	2327.63	
11	3.00	3.50	1818.71	
12	3.50	4.00	815.76	
13	4.00	4.50	523.77	
14	4.50	5.00	121.46	



Stantec UK Limited
Merchants' House North, Wapping Road
Bristol
BS1 4RW
Tel. +44 (0)117 945 9225
www.stantec.com/uk

Copyright Reserved
The Copyrights to all designs and drawings are the property of Stantec UK Limited. Reproduction or use for any purpose other than that authorised by Stantec is forbidden.
The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing. Any errors or omissions shall be reported to Stantec without delay.
Colour Disclaimer
This drawing has been documented in colour. This drawing is required to be printed in colour. Failure to do so may result in loss of information. Black and white printing may be used if specific black and white documents have been obtained from Stantec.

- All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
- The DWG file is issued for the purposes of coordination only and do not represent formal drawing issue and are not to be reprinted in any form. Formal issue of drawings is via DWF, Adobe PDF files and/or hard copies and their associated information issue sheets.
- Note that all care has been taken with the export of DWG files and their content, but we recommend that you make due dimensional checks before using any DWG file information. Any errors found are to be reported to Stantec immediately.
- All levels are shown in metres above Ordnance Datum (m AOD).
- Cut and fill isopachytes shown on this drawing are calculated from site strip to proposed formation levels. As such, they include existing construction thicknesses unless noted otherwise. They do not include the proposed new construction thicknesses.
- Cut and fill exercise does not allow for a bulking factor.
- The cut and fill isopachytes and volumes assume that all cut material are suitable to be re-used as fill material.
- The site strip thicknesses and volumes shown on this drawing are assumed and to be confirmed on site.
- Additional testing of head deposits is required to certain areas of the site and a volume of material may need to be stabilised prior to reuse as fill material.
- For the purposes of the cut / fill exercise the cut has been assumed as reusable fill material to a CBR of 2.5% in pedestrian areas, further testing required in vehicle areas. this is subject to confirmation of the onsite ground conditions and is confirmed as suitable re-use for fill material.**
- All earthworks are to be undertaken in conjunction with Stantec UK NBS Specification. Full method statement to be provided for approval by the Engineer prior to any work commencing on site.
- All cut and fill quantities are preliminary and are to be verified by quantity surveyor for cost estimating purposes.
- Refer to construction build ups for depth to formation.
- Volumes above are approx only. The contractor should make their own assessment on their accuracy and highlight any discrepancies where necessary.
- Any 3D models shared by Stantec should be for information only. The contractor should provide their own model and highlight any discrepancies against the drawings, where necessary.

A PRELIMINARY CBR VALUE OF 2.5% HAS BEEN USED FOR PRELIMINARY ANALYSIS.

CUT = MATERIAL TO EXPORT FROM SITE
FILL = MATERIAL TO IMPORT TO SITE

NOTE:
ANALYSIS HAS BEEN CARRIED OUT WITHIN THE EXTENTS OF THE REDLINE BOUNDARY FOR SITE. THE ANALYSIS DOES NOT INCLUDE AREAS WITHIN THE TREE ROOT PROTECTION ZONES AS THESE LEVELS WILL REMAIN UNCHANGED FROM THE EXISTING.

TABLE A - CONSTRUCTION BUILD-UPS		DEPTH
EXTERNAL WORKS:		
AREA 1: BUILDINGS		450mm TBC
AREA 2: ASPHALT (LIGHT)		220mm
AREA 3: ASPHALT (HEAVY)		590mm
AREA 4: PERMEABLE PAVING		590mm
AREA 5: LANDSCAPING		300mm OUTSIDE OF MADE GROUND EXTENT 600mm INSIDE OF MADE GROUND EXTENT

TABLE C - ADDITIONAL EXCAVATIONS (NOT ACCOUNTED IN SURFACE COMPARISON)		VOLUME
BELOW GROUND DRAINAGE / SERVICES TBC SUBJECT DETAILED DESIGN		TBCm³
FOUNDATIONS TBC SUBJECT DETAILED DESIGN		TBCm³
TOTAL		TBC

TABLE B - SURFACE COMPARISON	
VOLUME: BASE SURFACE: COMPARISON SURFACE: TOTAL CUT VOLUME: CUT VOLUME (WITHIN MADE GROUND EXTENT): FILL VOLUME:	EXISTING GROUND LEVEL PROPOSED FORMATION LEVELS 3655m³ 1444m³ 41605m³
NET VOLUME: 37950m³ FILL	

SUBSOIL CUT/FILL SUMMARY	
SURFACE COMPARISON (SEE TABLE B)	VS ADDITIONAL EXCAVATIONS (SEE TABLE C)
37950m³ FILL	TBC CUT

TOTAL ESTIMATED VOLUME	
SITE STRIP	& SUBSOIL SUMMARY
0m³	37950m³ FILL

P06: UPDATED TO NEW LAYOUT	JNLI	BM	08/07/2026
P05: UPDATED TO SUIT COMMENTS	JNLI	JM	16/03/2026
P04: UPDATED TO SUIT COMMENTS	JNLI	JM	06/03/2026
P03: UPDATED TO SUIT LAYOUT	JNLI	JM	26/02/2026
P02: UPDATED TO SUIT LAYOUT	AT	AT	15/12/2025
P01: FIRST ISSUE	JNLI	JM	09/07/2025
Issued/Revision	By	Appd	DD.MM.YYYY

Issue Status

S2 - FOR INFORMATION

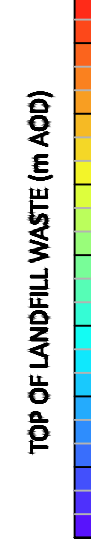
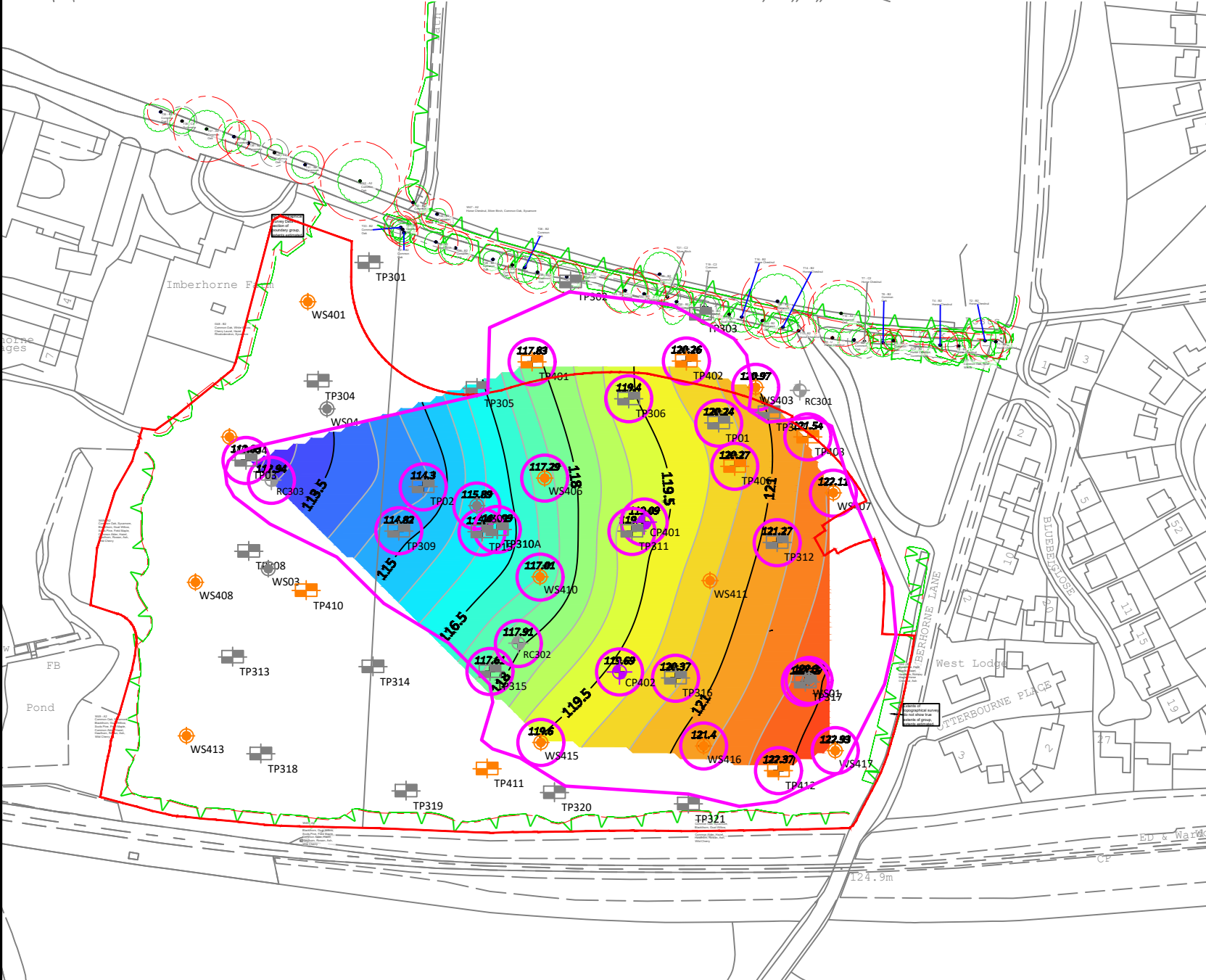
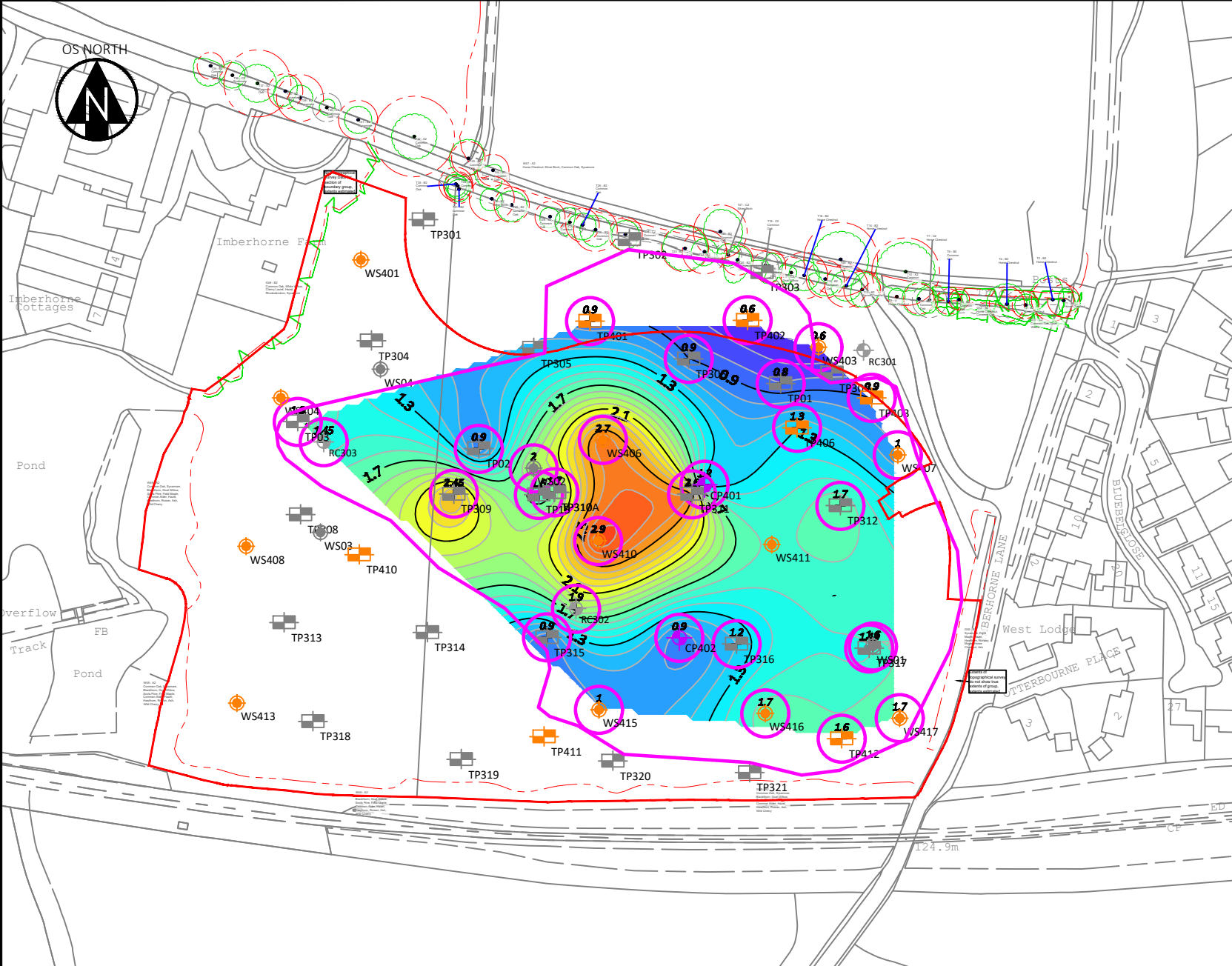
This document is suitable only for the purpose noted above. Use of this document for any other purpose is not permitted.

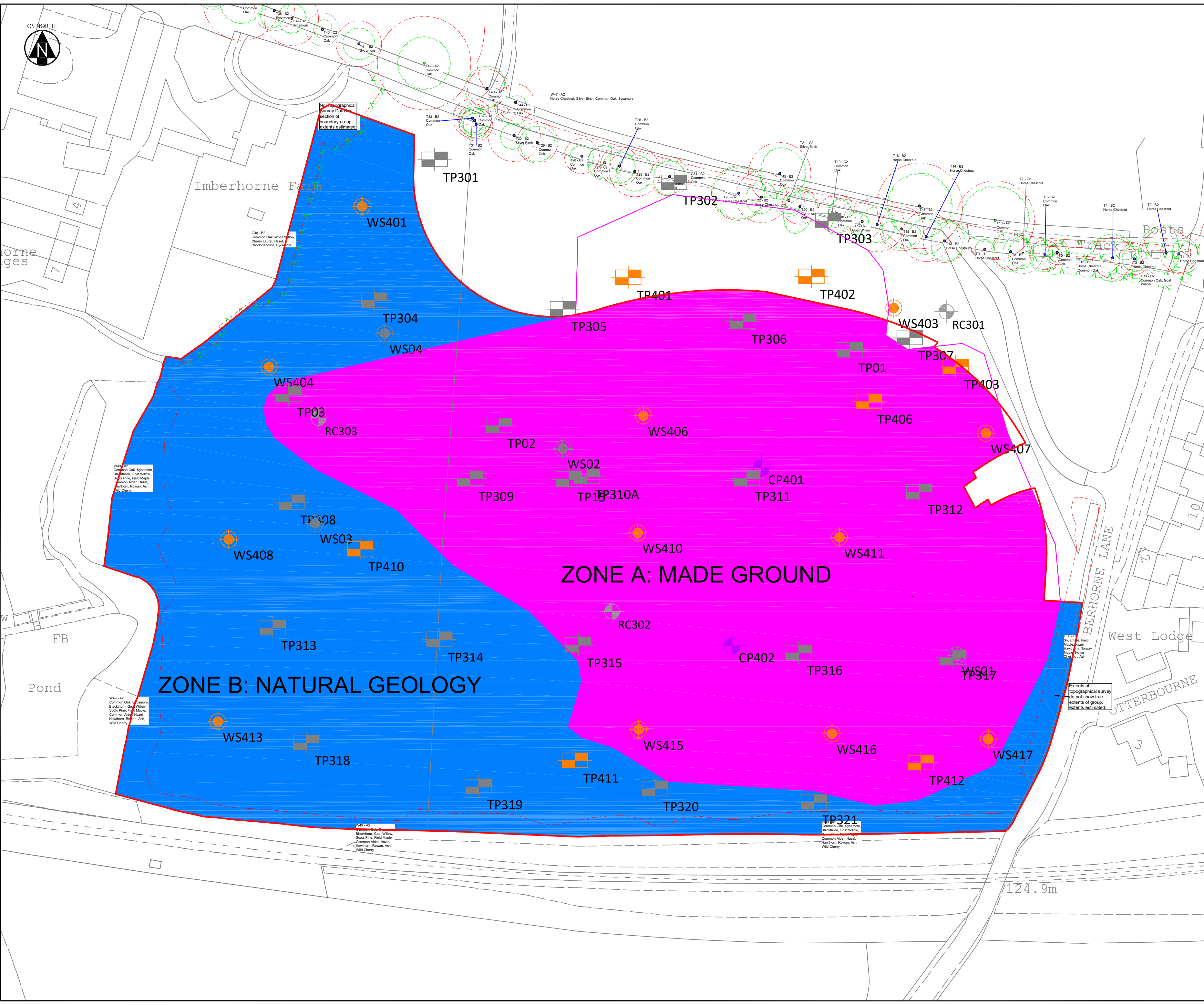
Client/Project
RANGFORD VILLAGES

IMBERHORNE FARM

Title
CUT AND FILL ANALYSIS

Project No. 26364	Scale AS SHOWN
Revision P06	Drawing No. 26364-STN-00-ZZ-DR-C-7400





KEY

- STANTEC 2026 BOREHOLE
- STANTEC 2026 WINDOW SAMPLE
- STANTEC 2026 TRIAL PIT
- HISTORICAL TRIAL PIT
- HISTORICAL BOREHOLE
- HISTORICAL WINDOW SAMPLE
- SITE BOUNDARY
- APPROXIMATE MADE GROUND EXTENT
- ZONE A: MADE GROUND
- ZONE B: LANDFILL WASTE

NOTES

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.

2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.

3. This drawing has been based on the following drawings and information: Greenhatch group Topographical Survey number: 55766_T dated: 23/09/25

4. Surfaces have been created using STANTEC Site Investigation. Levels and depths are accurate at investigation locations. Between investigation locations, levels and depths have been extrapolated and are indicative only.

P1	FIRST ISSUE				
EC		09/07/26	HG	09/07/26	
REV.	REVISION NOTES/COMMENTS				
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY

Hawthorn Park, Holdenby Road
Spratton,
Northampton, United Kingdom
NN6 8LD
Phone: +44 1604 842 888
Email: RLNTHHP@stantec.com
or visit www.stantec.com

CLIENT

RANGEFORD VILLAGES

PROJECT

IMBERHORNE

TITLE

FOUNDATION ZONATION PLAN

STANTEC PROJECT NUMBER	SCALE @ A2
333701756	1:750
PURPOSE OF ISSUE	STATUS
SUITABLE FOR INFORMATION	S2
DRAWING NUMBER	REVISION
333701756-STN-XX-XX-DR-GE-0007	P1



KEY

- STANTEC 2026 BOREHOLE
- STANTEC 2026 WINDOW SAMPLE
- STANTEC 2026 TRIAL PIT
- HISTORICAL TRIAL PIT
- HISTORICAL BOREHOLE
- HISTORICAL WINDOW SAMPLE
- SITE BOUNDARY
- APPROXIMATE MADE GROUND EXISTING
- ZONE A: MADE GROUND
- ZONE B: LANDFILL WASTE

NOTES

- All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
- This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.
- This drawing has been based on the following drawings and information: Greenhatch group Topographical Survey number: 55766_T dated: 23.09.25
- Surfaces have been created using STANTEC Site Investigation. Levels and depths are accurate at investigation locations. Between investigation locations, levels and depths have been extrapolated and are indicative only.

P1					
EC	09/07/26	HS	09/07/26		
REV					
REVISION NOTIFICATION					
DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
Hawthorn Park, Hoddleby Road Spartan, Northampton, United Kingdom NW6 8LD Phone: +44 1604 842 888 Email: RL_NTH@stantec.com or visit www.stantec.com					
CLIENT					
RANGEFORD VILLAGES					
PROJECT					
IMBERHORNE					
TITLE					
FOUNDATION ZONATION PLAN					
STANTEC PROJECT NUMBER			SCALE @ A2		
333701756			1:750		
PURPOSE OF ISSUE					STATUS
SUITABLE FOR INFORMATION					S2
DRAWING NUMBER					REVISION
333701756-STN-XX-XX-DR-GE-0007					P1