



The Fairways, Westhoughton

Phase 2 Geo-Environmental Investigation Report

For: Bellway Homes (Manchester) Ltd

Innovative Geo-Environmental Engineering

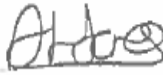
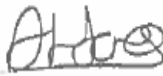
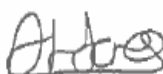
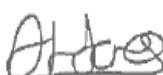
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Rev A	29 th April 2021	 Angharad Jones	 Andrew Edwards	Updated Sections 3.7, 3.8, 4.1.2, 6.0 and Appendix 8
Rev B	13 th May 2021	 Angharad Jones	 Andrew Edwards	Updated Section 1.0 and Appendix 2 with updated proposed development plan.
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1.0 INTRODUCTION

This Geo-Environmental Ground Investigation Report has been prepared at the request of Bellway Homes (Manchester) Ltd. Instructions to proceed were received in October 2020.

This report pertains to a c. 14Ha site located to the west and east of Dobb Brow Road, Westhoughton, c. 500m south west of Westhoughton town centre. The approximate postcode for the site is BL5 2BA and the National Ordnance Survey Grid Reference for the centre of the site is 364742E, 405757N. The site is part of a wider Bellway Homes development and pertains to Phases 3 – 5 of the masterplan shown below:



Figure 1 - Extract from Bellway Homes drawing 'Westhoughton; Further Phases – Scheme Parameters' (dated: Nov 2020)

The site currently comprises numerous open fields with associated hedgerows, ponds and vegetated areas. The site is bound by open fields and a golf course to the north and east, residential properties and open fields to the south and a railway to the west. Access to the site is off Dobb Brow Road which runs through the centre of the site. A site location plan (SI-01) is contained in Appendix 2. A recent aerial view of the site is shown below:



Figure 2 - Aerial image of the site dated February 2021. The site boundary is highlighted in magenta.

Proposed Development

This Combined Phase 2 Geo-Environmental Investigation and Coal Mining Risk Assessment Report (CMRA) is to be used for submission to the Local Authority as part of 2 No. planning applications as it is the Client's intention to develop the site into a low-rise residential development with associated private gardens, areas of soft landscaping and highways. Development Phases 3 and 4 will be submitted as a single planning application and Development phase 5 as a separate stand-alone application, the development phases are shown in the masterplan included in Section 1.0

A proposed development phase plan is included in Appendix 3.

1.1 Brief

The brief was to carry out an intrusive geo-environmental ground investigation for the site based upon the proposed developments outlined in Section 1.0 and following the findings and recommendations of the *IGE Consulting Combined Phase 1 Geo-*

Environmental Investigation and Coal Mining Risk Assessment Report (March 2021).

The investigation was to include the following tasks:

- a) Undertake / install appropriate exploratory holes and collect representative samples from exploratory holes and arrange appropriate chemical testing in accordance with the latest legal framework, record olfactory and / or visual evidence of contamination during intrusive works and undertake on site in-situ and laboratory geotechnical testing;
- b) Formulate conceptual models to accommodate the findings of the site investigation works in terms of the risk to human health, ground gas, controlled waters and the wider environment;
- c) Identify the risks and evaluate whether a Phase 3 numerical risk assessment and / or a Remedial Strategy, is required;
- d) Undertake an assessment of the ground conditions findings to provide outline recommendations for the proposed foundations.
- e) Undertake additional trial pits to inspect unknown services identified on the GPR survey.

A report was to be provided to summarise the findings and recommendations.

1.2 Third Parties

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2.0 SCOPE OF INVESTIGATION WORK

This Geo-Environmental Ground Investigation has been designed following the findings and recommendations of the *IGE Consulting Combined Phase 1 Geo-Environmental Investigation and Coal Mining Risk Assessment Report* (March 2021) and Client requirements in relation to the proposed developments outlined in Section 1.0.

The ground investigation works were undertaken between the 1st February and 4th February 2021 and comprised 41 No. trial pits and 21 No. window sample holes. Subsequent chemical and geotechnical laboratory testing was undertaken between 10th February and 3rd March 2021. An additional 15 No. trial pits (TP101 – TP115) were undertaken on 14th May to inspect and identify unknown services recorded on the GPR scan. All the exploratory hole positions were surveyed with X-Y-Z axis accuracy of 20mm.

Drilling of window sample holes was carried out by Geo Site Surveys Ltd. Testing of soil samples for environmental and geotechnical purposes was carried out by i2 Analytical in accordance with the Environment Agency's MCERTS (Monitoring Certification) quality assurance accreditation scheme. These organisations were appointed directly by IGE Consulting to carry out these contracting works. The ground investigation was undertaken in general accordance with:

- BS 5930 (2015) Code of Practice for Ground Investigation;
- BS 1377 (1990) Methods of test for Soils for Civil Engineering Purposes;
- BS 10175 (2011) Investigation of Potentially Contaminated Sites – Code of Practice; and
- BS EN 1997-2 (2007) Eurocode 7 – Geotechnical Design – Ground Investigation and Testing.

The sampling strategy for the site has been completed in accordance with CLR4 and the design of the investigation was carried out in accordance with R&D Technical Report P 5-TR066, LCRM (2020) and BS:8485 (2015) + A1 (2019). Further details

pertaining to the site investigation works are outlined in the following sections. The limitations of the investigation work and report are included in Appendix 1.

Trial pits and window samples were undertaken in order to achieve the following:

- to establish the thickness, extent and characteristics of made ground (if present) and underlying natural superficial deposits;
- to determine the presence of possible obstructions i.e. relic footings and slabs;
- to undertake in-situ geotechnical testing within these deposits;
- to obtain samples from these deposits for classification and laboratory testing;
- to allow for the installation of ground gas and groundwater monitoring wells (WS02, WS03, WS06, WS07, WS11, WS14A, WS18 and WS21).
- to inspect and identify unknown services recorded on the GRP scan.

2.1 Trial Pits

In total, 41 No. trial pits were undertaken to depths of between 2.20m and 3.00m bgl (93.62m and 85.53m AOD). The trial pits were placed spatially across the site to gain a representative view of the ground conditions as well as on a targeted basis. The following trial pits targeted pertinent features:

- TP26 & TP36 targeted an infilled pond to the south of the site.
- TP07 and TP40 targeted a potential infilled pond identified during investigation works (also targeted by WS21 as described below).

An additional 15 No. trial pits (TP101 – TP115) were undertaken to depths of between 0.50m and 2.50m bgl (87.24m and 91.10m AOD), in order to inspect and identify unknown services recorded on the GPR scan.

The locations of the trial pits are shown on the exploratory hole location plan (SI-05) contained in Appendix 2 and the trial pit logs and photographs are included in Appendix 4.

2.2 Window Sample Holes

In total 21 No. window sample holes were undertaken to depths of between 2.45m and 4.45m bgl (92.53m and 84.93m AOD). The window sample holes were mostly placed spatially across the site to gain a representative view of the ground conditions. The following window samples targeted pertinent features:

- WS21 targeted a potential infilled pond identified during investigation works (also targeted by TP07 and TP40 as described above).

The following window sample holes were installed with standpipes to allow for monitoring of the underlying groundwater depth, if present, together with ground gas concentrations:

Exploratory Hole	Response Zone Strata	Response Zone Depth m bgl (m AOD)	
		Top of Response Zone	Base of Response Zone
WS02	GLACIAL TILL comprising firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY.	1.00 (89.72)	4.00 (86.72)
WS03	GLACIAL TILL comprising firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY.	1.00 (88.51)	4.00 (85.51)
WS06	GLACIAL TILL comprising firm to stiff, brown, slightly sandy, silty CLAY.	1.00 (91.71)	4.00 (88.71)
WS07	GLACIAL TILL comprising firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY.	1.00 (88.38)	4.00 (85.38)
WS11	GLACIAL TILL comprising firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY.	1.00 (89.65)	4.00 (86.65)
WS14A	GLACIAL TILL comprising firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY.	1.00 (89.29)	4.00 (86.29)
WS18	GLACIAL TILL comprising firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY. AND GLACIAL TILL comprising medium dense, brown, gravelly SAND	1.00 (92.11)	4.00 (89.11)
WS21	ORGANIC CLAY comprising very soft to soft, grey to dark grey, slightly sandy, silty CLAY.	1.00 (93.95)	3.00 (91.95)

The monitoring wells are constructed of a 50mm diameter HDPE plain pipe to the depth of the response zone which is screened with slotted pipe with bentonite seals. The monitoring wells were topped with metal top hats protruding 0.50m above ground level with lockable covers.

The locations of the window sample holes are shown on the exploratory hole location plan in Appendix 2 and the window sample hole logs are contained in Appendix 5.

2.3 Site Testing and Sampling

The following site tests and sampling was carried out:

- a) Retrieval of bulk disturbed samples from trial pits for the purposes of laboratory testing and classification.
- b) Where possible, in-situ (<1.20m bgl in trial pits only) and ex-situ shear strength testing was undertaken within cohesive / fine grained material (clay) from the trial pits and window sample holes using a hand shear vane (HSV) 19mm vane in accordance with BS1377-9.
- c) Standard Penetration Tests (SPTs) were undertaken at regular 1.00m intervals between 1.00m and 5.45m bgl within the window sample holes.

2.4 Laboratory Testing

2.4.1 Chemical Laboratory Testing

24 No. soil samples were sub-sampled from the samples obtained during exploratory hole construction and sent to i2 Analytical laboratories for chemical testing. These samples were placed into sterile sealed containers to facilitate MCERTS chemical laboratory testing of potential contaminants. Chemical testing suites were based upon a wide range of possible contaminative sources, outlined below:

Asbestos ID and quantification if positively identified, sulphate, pH, nitrate, total and free cyanide, arsenic, barium, beryllium, boron, cadmium, chromium, chromium (hexavalent), copper, lead, mercury, nickel, selenium, vanadium, zinc, total petroleum hydrocarbon screen, speciated total petroleum hydrocarbon fractions (TPHCWG), speciated polyaromatic hydrocarbons (PAHs), BTEX and MTBE.

Based on the findings of the *IGE Consulting Phase 1 Geo-Environmental Report* (March 2021), the following targeted chemical testing was also undertaken:

- *Topsoil samples were tested for Herbicides and pesticides.*

2.4.2 Geotechnical Laboratory Testing

The following geotechnical laboratory tests were carried out on selected samples obtained from across the site:

- a) Determination of moisture content, liquid limit and plastic limit in accordance with BS1377 Part 2, Methods 3.2, 4.4 and 5.0 (1990).
- b) Determination of moisture condition value (MCV) in accordance with BS1377, Part 4, Clause 5.4 (1990).
- c) Sedimentation analysis by hydrometer method in accordance with BS1377-2 (1990), Methods 9.2 and 9.5.
- d) Determination of particle size analysis by dry / wet sieving in accordance with BS1377 Part 2, Method 9.2 (1990).

3.0 FINDINGS

3.1 Ground Conditions

The below ground conditions have been separated into their respective proposed development phases.

The approximate proposed development phases are shown in the figure below:

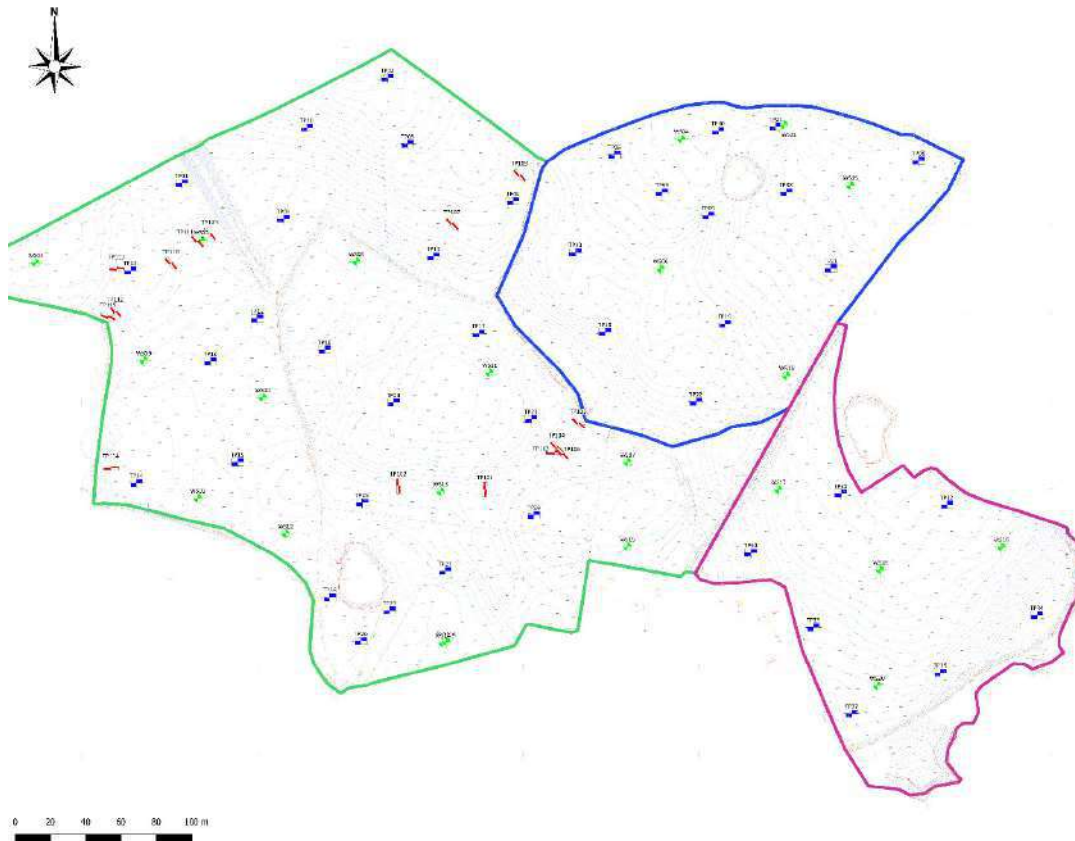


Figure 3 – Plan showing the development phases. Pink = Phase 3, Blue = Phase 4 and Green = Phase 5.

3.1.1 Phase 3 (Eastern Site Section)

The typical ground conditions encountered in Phase 3 comprised:

- TOPSOIL comprising dark brown, clayey SAND with frequent rootlets and occasional gravel to a depth of between 0.25m and 0.40m bgl (93.24m and 87.83m AOD) underlain by;

- GLACIAL TILL comprising firm, orangish brown, slightly sandy, silty CLAY with occasional gravel and rare cobbles to a depth of between 0.80m and 2.65m bgl (92.64m and 89.25m AOD), underlain by;
- GLACIAL TILL comprising firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY with rare cobbles to a depth of between 1.90m and 3.00m bgl (91.04m and 85.53m AOD), underlain by;
- GLACIAL TILL comprising medium dense, brown, clayey SAND to a depth of at least 4.45m bgl (88.24m AOD).

Phase 3 Notable Exceptions

The following notable exceptions were recorded as summarised below:

- ALLUVIUM comprising wet brown SAND and GRAVEL to a depth of between 1.30m to at least 2.30m bgl (at least 88.13m to 86.78m AOD) – these deposits were anticipated to be associated with the Pennington Brook and were present in a localised area in the vicinity of the stream in TP34 and TP35 only.

3.1.2 Phase 4 (Northern Site Section)

The typical ground conditions encountered in Phase 4 were noted to be variable with the typical ground conditions comprising the following:

- TOPSOIL comprising dark brown, clayey SAND with frequent rootlets and occasional gravel to a depth of between 0.25m and 0.55m bgl (95.72m and 90.63m AOD), underlain by;
- GLACIAL TILL comprising soft to firm, orangish brown, sandy CLAY with occasional gravel to a depth of 0.55m and 2.70m bgl (94.82m and 88.78m AOD), underlain by;
- GLACIAL TILL comprising wet to damp, brown to dark grey, silty SAND with occasional gravel to a depth of at least 3.45m bgl (88.18m AOD)
- [in places] GLACIAL TILL comprising greyish brown to brown, sandy SILT with rare gravel to a depth of at least 2.50m bgl (93.62m AOD).

Phase 4 Notable Exceptions

In addition to a suspected infilled pond area along the northern boundary (discussed in Section 3.1.4 below), an additional 2 No. soft areas were encountered in Phase 4.

These were encountered in TP09 and TP21 in the central and the eastern site section of area 2:

- TP21 from 0.25m bgl (94.98m AOD) to a depth of at least 2.70m bgl (92.53m AOD): Firm orangish brown, slightly sandy, silty CLAY with occasional gravel, becoming soft to firm from 1.60m bgl, soft from 2.00m bgl and very soft and wet from 2.20m bgl.
- TP09 from 1.00m bgl (92.47m AOD) to a depth of at least 2.70m bgl (90.77m AOD): Soft, grey, sandy, silty, organic CLAY with occasional rootlets and wood fragments, with a cobble sized pocket of peat between 1.10m – 1.60m bgl.

3.1.3 Phase 5 (South Western Site Section)

The typical ground conditions encountered in Phase 5 were noted to be consistent and comprising the following:

- TOPSOIL comprising dark brown, clayey SAND with frequent rootlets and occasional gravel to a depth of between 0.20m and 0.40m bgl (94.28m and 88.06m AOD), underlain by;
- GLACIAL TILL comprising firm orangish brown, slightly sandy, silty CLAY with occasional gravel and rare cobbles to a depth of between 0.65m AND 1.50m bgl (93.93m and 87.64m AOD), underlain by;
- GLACIAL TILL comprising firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY with rare cobbles to a depth of at least 4.45m bgl (84.93m AOD).

Phase 5 Notable Exceptions

The following notable exceptions were recorded as summarised below:

- GLACIAL TILL comprising orangish brown, clayey SAND between 1.10m – 1.60m bgl (90.13m – 89.40m AOD). This thin sand band was encountered in both TP01 and TP04 in the north western section of phase 5.
- GLACIAL TILL comprising greyish brown to brown, sandy SILT with rare gravel between 1.10m – at least 2.60m bgl to a depth of at least 2.60m bgl (91.99 - 89.75m AOD). This underlying silt stratum was encountered in TP05 and TP41. In the north of phase 5

3.1.4 Suspected Infilled Ponds

2 No. areas of suspected infilled ponds were encountered in the northern and southern site boundaries in the vicinity of existing on-site ponds within Phase 4 and 5 development areas.

Northern Infilled Pond (Phase 4):

The northern infilled pond area was characterised by very soft to soft organic CLAY with occasional gravel to boulder sized pockets of peat encountered in some of the holes. TP07, TP40 and the targeted WS21 encountered these soft, organic clay deposits. TP40 is suspected to have encountered the edge of the infilled pond and the base at 1.90m bgl (92.95m AOD) in this area. WS21 was undertaken in the vicinity of the suspected infilled pond and did not encounter the base, with very soft to soft clay extending to a depth of at least 3.45m bgl (91.50m AOD). The figure below shows the estimated extent of the infilled pond:

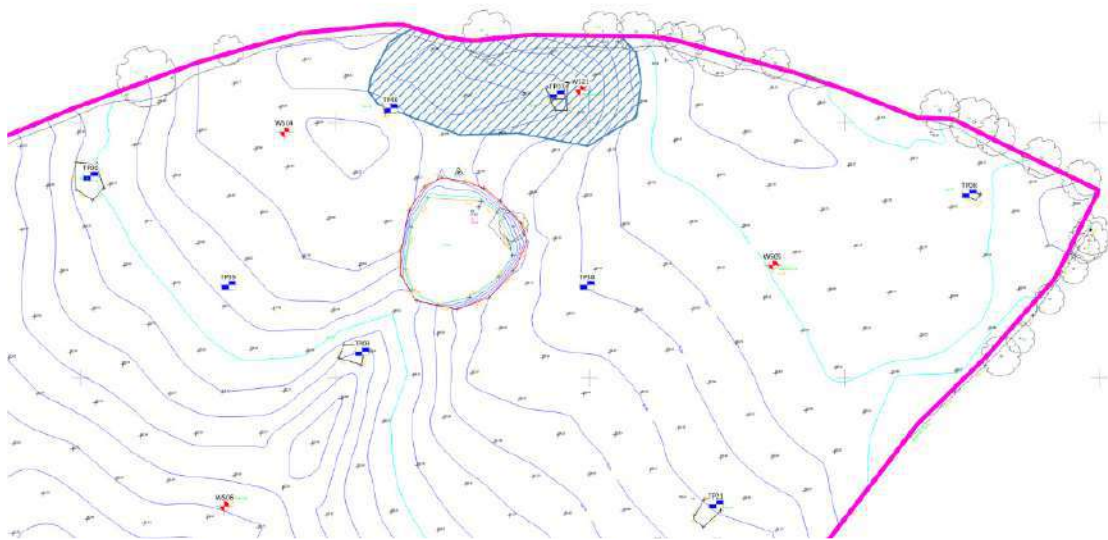


Figure 4 - Estimated extent of the infilled pond in the northern site section (blue hatch).

Southern Infilled Pond (Phase 5):

Following the *IGE Consulting Phase 1 Geo-Environmental Report* (March 2021) a historic pond was targeted in the southern site section next to an existing on-site pond. TP26 and TP36 encountered soft to very soft, silty organic CLAY with occasional gravel to cobble sized pockets of peat. The base of the suspected infilled pond was not encountered and the organic clay stratum extended to at least 2.70m bgl (87.09m AOD).

Given this pond was recorded on historic maps, it is likely that the pond was infilled, however, no anthropogenic constituents were noted within the excavated material. The estimated location of the southern infilled pit is shown in the figure below:

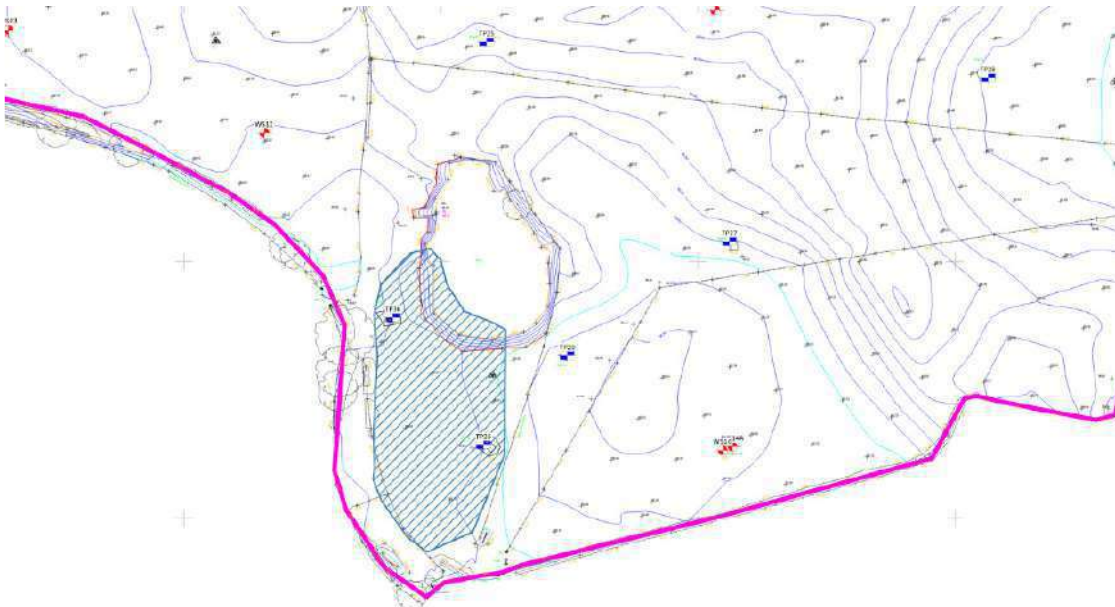


Figure 5 - Estimated extent of the infilled pond in the southern site section (blue hatch).

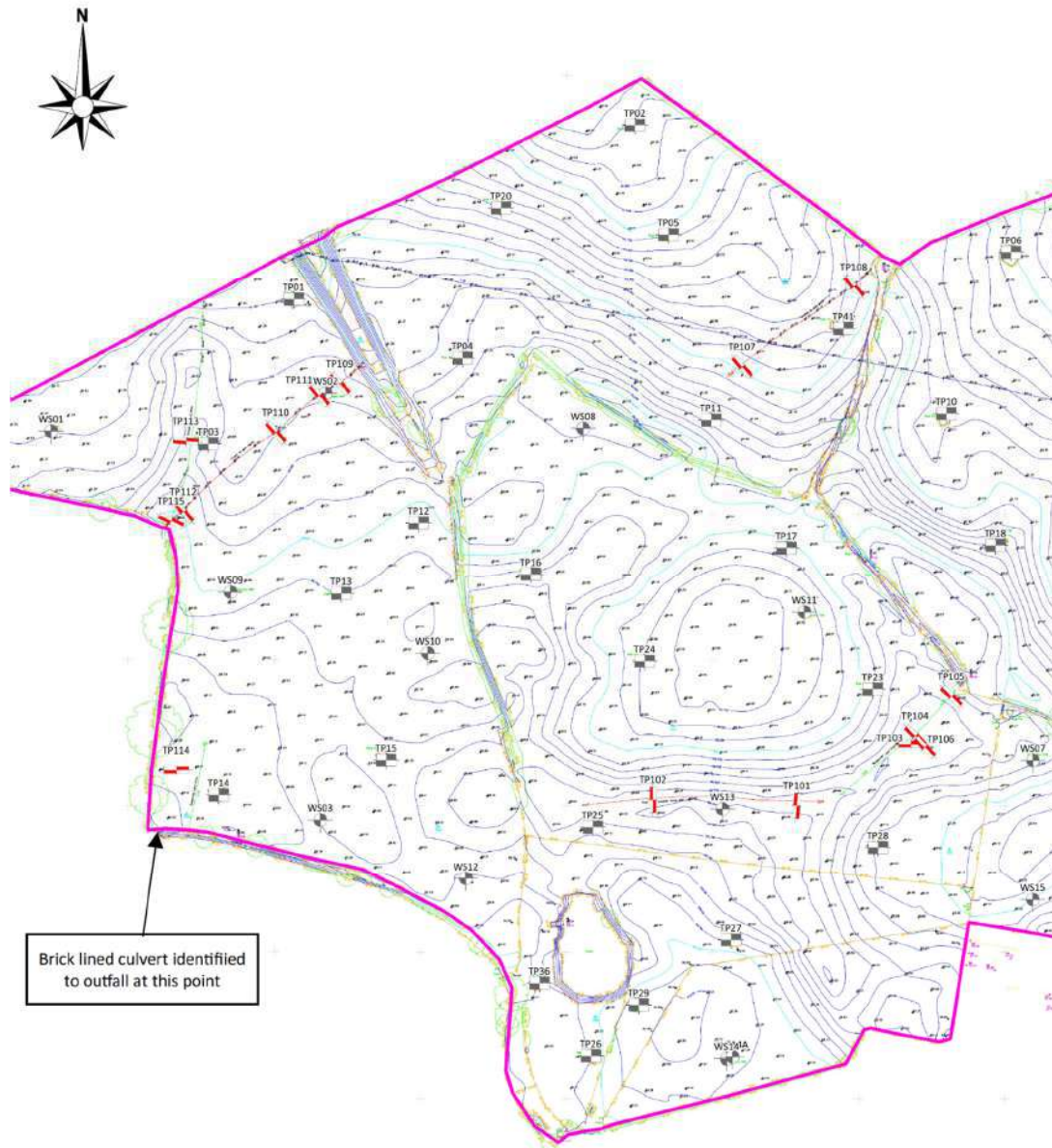
3.1.5 Ground Obstructions

No significant ground obstructions were encountered during the site investigation works. However, cobbles and rare boulders were encountered across the site within the deeper glacial till deposits.

For further details please refer to the trial pit and window sample logs contained in Appendix 4 and 5 respectively.

3.1.6 Service Inspection Pits

15 No. additional trial pits (TP101 – TP115) were undertaken in Development Phase 5 to inspect and identify unknown services recorded on the GPR scan as well as to determine the position of a red brick culvert noted to emerge along the western boundary. An extract of the service inspection pits plan (SI-08) showing the unknown services is included below:



TP101 – TP106 were undertaken in the central southern section of development phase 5. A 0.10m diameter ceramic land drain was recorded in TP101 and TP102 at between 0.60m and 0.70m bgl. A 0.20m diameter ceramic land drain was also recorded in TP105 and TP106 at between 0.50m and 0.60m bgl. No services were recorded in TP103 and TP104.

TP107 – TP108 were undertaken in the northern section of development phase 5, no services were recorded.

TP109 – TP112 and TP115 were undertaken in the north western section of development phase 5. No services were recorded in any of the pits with the exception of in TP112 where 2 No. x 0.10m diameter land drains at 0.70m and 0.80m bgl.

TP113 was also undertaken in the north west section of development phase 5 to target a second unknown service and recorded a 0.10m diameter ceramic land drain at 1.00m bgl.

TP114 was undertaken in the western site section to determine the route of the red brick culvert identified along the boundary, the trial pit was pulled into a 20m long trench, however, the culvert was not identified. The route of the culvert is therefore still unknown, however it is suspected to run along the western boundary. It is recommended that a CCTV survey is undertaken to determine its exact location due to possible implications on the proposed development.

3.2 Visual and Olfactory Contamination Findings

During the intrusive exploratory hole investigation works, the soils were examined carefully for both visual and olfactory evidence of contamination, no evidence of visual or olfactory evidence of contamination was noted. However, organic odours were noted associated with suspected infilled ponds in the northern and southern site sections. The following organic odours were recorded:

Visual or Olfactory Evidence of Contamination	Exploratory Hole	Depth (m bgl)	Strata
Slight Organic Odour	TP07	0.70 – 1.10	MADE GROUND
	TP26	0.40 – 2.70	ORGANIC CLAY
	WS21	0.80 – 3.45	ORGANIC CLAY
Organic Odour	TP07	1.10 – 3.00	ORGANIC CLAY
	TP09	1.00 – 2.70	ORGANIC CLAY

3.3 Water Strikes

Water strikes were recorded in the following locations and depths:

Strata	Exploratory Hole	Depth (m bgl)	Comments
ALLUVIUM	TP34	0.90	Moderate Ingress
GLACIAL TILL (GRANULAR)	TP06	2.15	Slight Ingress
	TP08	1.90	Slight ingress
	WS04	1.80	Recorded as wet
	WS05	2.60	Recorded as wet
	WS17	3.25	Recorded as wet
GLACIAL TILL (COHESIVE)	TP14	0.80	Rapid ingress from land drain
	TP15	0.80	Rapid ingress from land drain
	TP18	2.05	Rapid uprising from granular strata below under hydrostatic pressure
	TP21	2.20	Clay is wet
	TP22	2.20	Slight ingress
	TP40S	1.80	Slight ingress near cohesive / granular interface
MADE GROUND	TP07	0.70	Slight ingress
ORGANIC CLAY	TP07	1.40	Moderate ingress
	TP09	1.90	Slight ingress
	TP26	0.40	Slight ingress
	TP36	1.45	Slight ingress
	TP40N	1.80	Slight ingress near cohesive / granular interface

Water strikes were mainly perched within granular deposits or associated with land drains. However, an uprising of water under hydrostatic pressure was recorded within TP18. This was interpreted to be trapped perched water within granular deposits lying beneath cohesive deposits. The overlying non-permeable clays in this area are loading the granular deposits beneath and causing hydrostatic pressure.

Additionally, the ground was noted to be waterlogged across large areas of the site. A potential collapsed land drain was also noted with uprising water (possibly associated with hydrostatic pressure as discussed) in this area. For further details of area affected please refer to the Indicative Hydrological Features Plan is contained in Appendix 2 (SI-07).

Further details and recommendations regarding the water management required during development of the site is discussed in Section 5.3.

For further details pertaining to the water strikes please refer to the exploratory hole logs in Appendices 4 and 5.

3.4 Geotechnical Site Testing

The results of the in-situ site tests undertaken during the site investigation are summarised below.

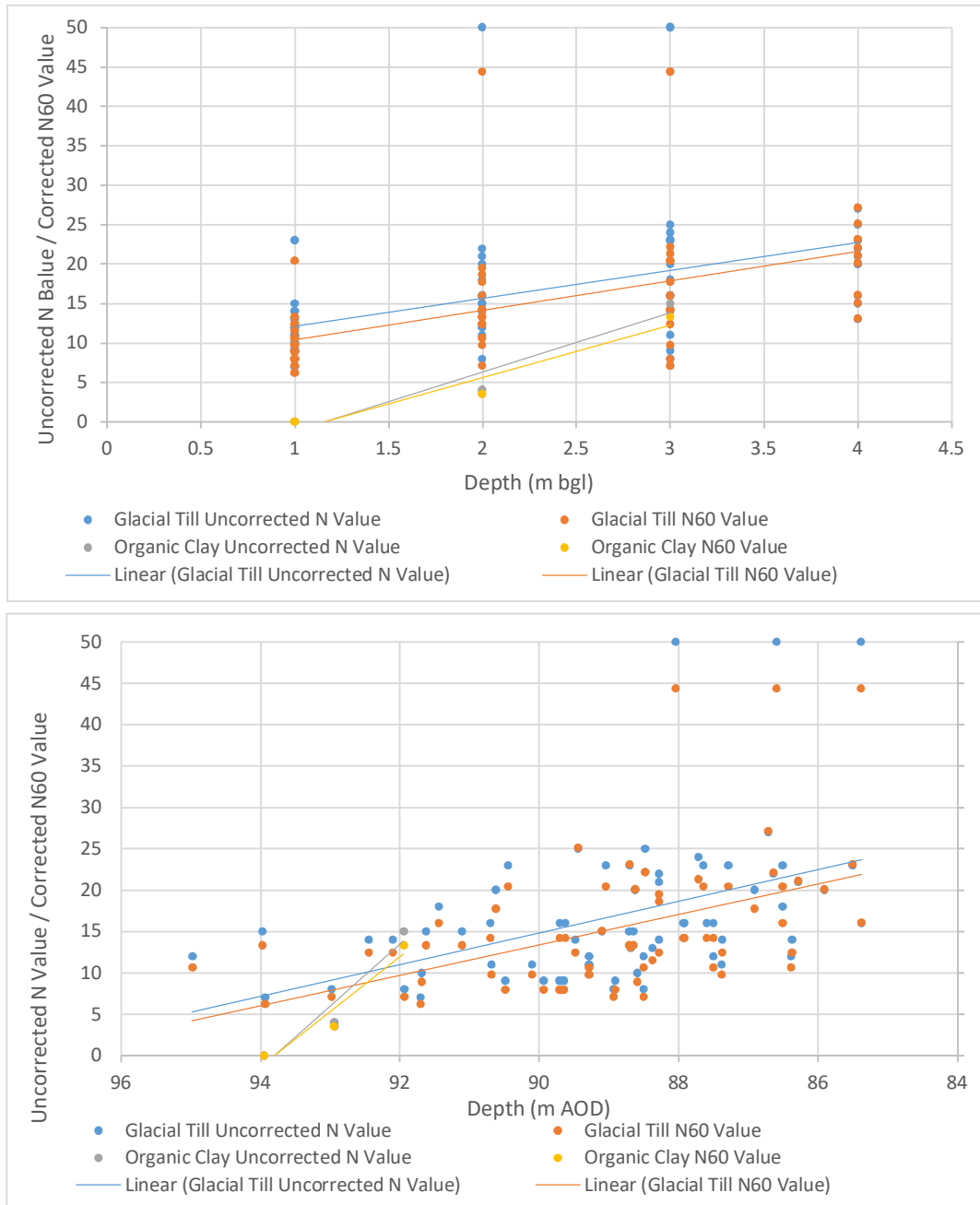
3.4.1 Standard Penetration Tests

SPT tests were undertaken during the construction of the window sample holes. SPT energy ratio = 71%. The following table outlines the uncorrected N-Values and corrected N₆₀ values derived from the SPT tests undertaken in the glacial till deposits during the site investigation works:

Deposit Type	Depth Range of Test Start Depths m bgl (m AOD)	Number of Tests	Uncorrected N-Value Range	Uncorrected N-Value Average	Corrected N ₆₀ Range	Corrected N ₆₀ Average
Glacial Till	1.00 – 4.45 (94.98 – 85.38)	71	4 – 50+	17*	4 – 44+	15*
Organic Clay	1.00 – 4.45 (93.95 – 91.50)	3	0 - 15	6	0 - 13	6

*Where an N-value of 50+ (refusal) was recorded, a value of 50 was used to calculate the arithmetic mean and to convert to N₆₀.

The following scatter graphs shows a consistent increase in shear strength with depth (both m bgl and m AOD).



Utilising the *Stroud and Butler (1975)* correlation between SPT N values and undrained shear strengths in low plasticity clays ($PI < 20$), the N values for depths between 1.00m and 4.45m bgl have been used semi-empirically to calculate approximate equivalent shear strength of the glacial till.

Depth (m bgl)	Average Shear Strength (c_u) (kN/m ²)
1.00 – 1.45	67
2.00 – 2.45	98
3.00 – 3.45	126
4.00 – 4.45	123

For detailed, specific information pertaining to the SPT tests, please refer to the window sample hole logs contained within Appendix 5.

3.4.2 Hand Shear Vane (19mm) Tests

In total, 927 No. in-situ (<1.20m bgl within trial pits) and ex-situ hand shear vane tests were undertaken on samples of cohesive material (clay) within trial pit and window sample hole samples using a hand shear vane (19mm vane) in accordance with BS1377-9.

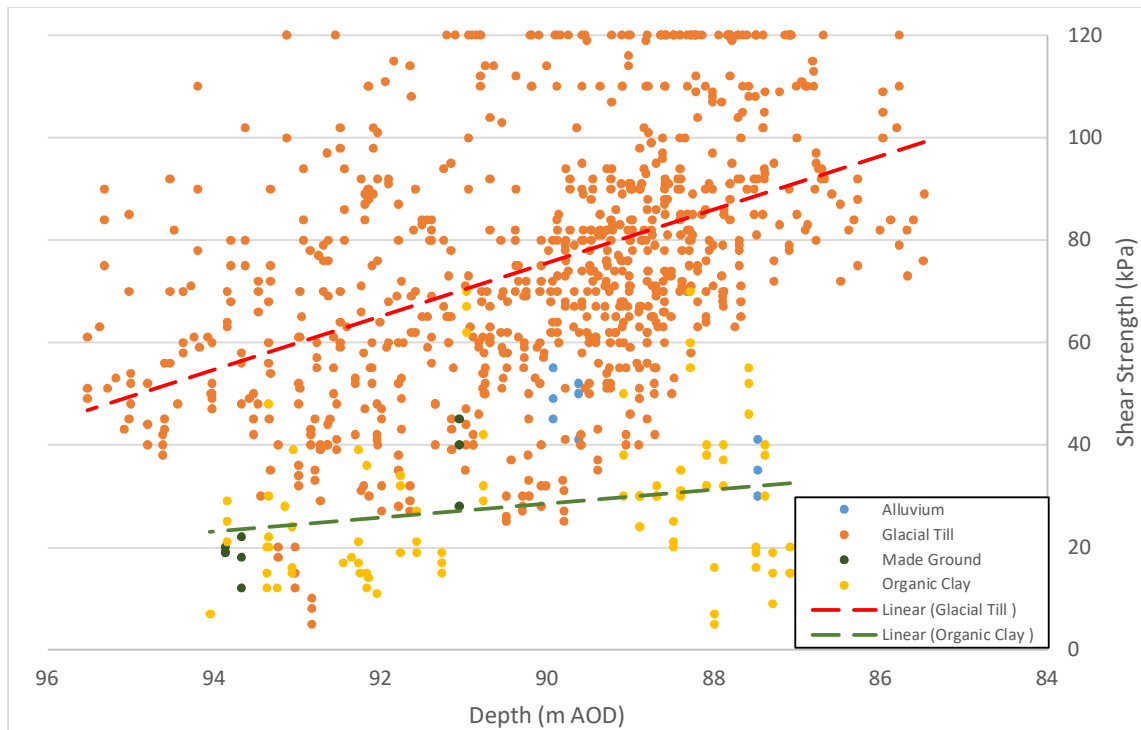
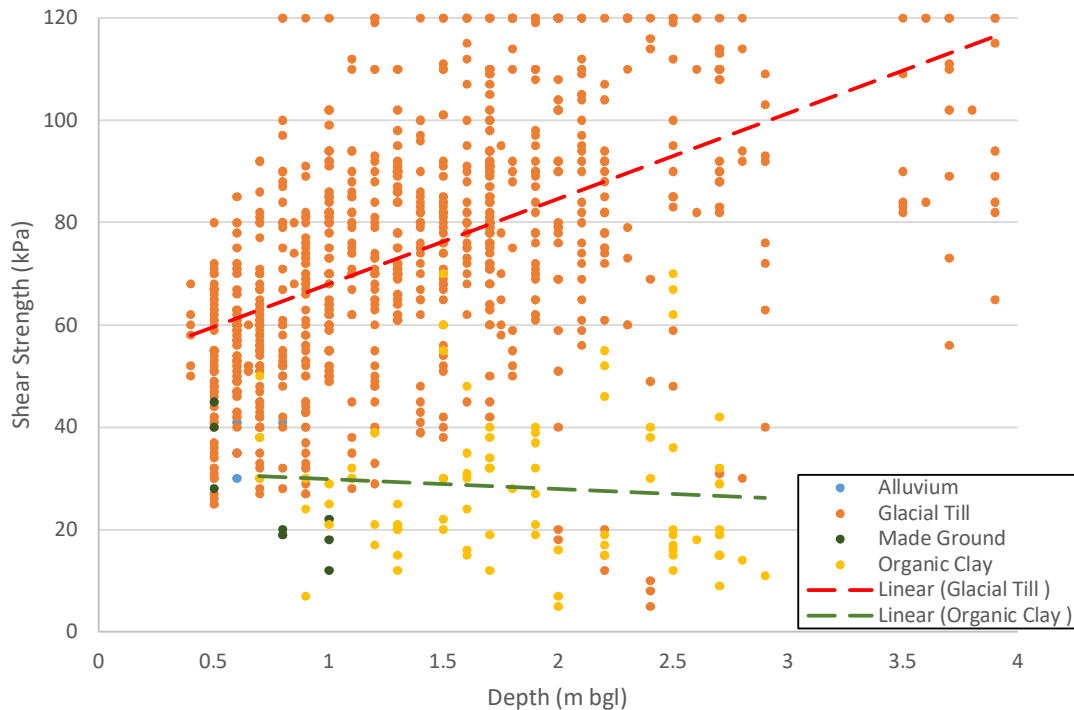
The following table outlines the undrained shear strength values obtained within the underlying ground conditions during the site investigation split into stratum type:

Deposit Type	Number of Tests	Depth Range m bgl (m AOD)	Shear Strength Range (kPa)	Shear Strength Average (kPa)
Made Ground	9	0.50 – 1.00 (91.06 – 93.87)	12 – 45	25
Alluvium	9	0.50 – 0.80 (87.48 – 89.93)	30 – 55	44
Organic Clay	85	0.70 – 2.90 (87.09 – 94.05)	5 – 70	28
Glacial Till	824	0.40 – 3.90 (85.48 – 95.52)	5 – 120+*	75

*Where hand shear vane test results have been recorded as 120kPa, maximum limit of shear vane has been reached and shear strength is 120kPa+. A value of 120 is used in this case to calculate the arithmetic mean.

The following scatter graphs show the correlation of shear strength and depth within the glacial till, alluvium, organic clay and made ground. As only a limited number of hand shear vane tests were undertaken within the alluvium and made ground no significant correlation can be made. However, a notable increase in shear strength

with depth is evident within the glacial till, and a slight decrease in shear strength with depth in the organic clay within the infilled ponds. The hand shear vane results in the glacial till and organic clay are highly variable, anticipated to be due to the presence of secondary granular constituents (i.e. silt, sand and gravel). The variable shear strength within the glacial till is also anticipated to be due to the presence of water bearing granular bands which have caused localised softening of the glacial till.



For detailed, specific information pertaining to the hand shear vane tests, please refer to the trial pit and window sample hole logs contained within Appendix 4 and 5 respectively.

3.5 Geotechnical Laboratory Testing

The results of the geotechnical laboratory tests undertaken during the site investigation are summarised below.

3.5.1 Atterberg Limit Tests

Atterberg limit tests were undertaken on 9 No. samples from natural glacial till deposits. The results of the Atterberg testing are as follows:

Location	Depth (m bgl)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Passing through 425 micron (%)	Modified Plasticity Index
TP08	1.10	24	36	18	18	84	15
TP10	0.50	36	44	31	13	100	13
TP11	0.70	26	40	21	19	87	17
TP14	1.00	26	44	21	23	100	23
TP17	1.00	15	38	18	20	90	18
TP27	1.10	12	39	22	17	94	16
TP32	1.20	19	37	26	11	90	10
TP33	1.30	15	32	18	14	83	12
TP34	1.40	16	34	16	18	77	14
Average		21	38	21	17	89	15

Green = low plasticity / volume change potential.

Yellow = moderate plasticity / volume change potential.

The Atterberg Limit tests indicate that the glacial till clay deposits are on average of **low plasticity** / volume change potential, in-line with NHBC Chapter 4.2 guidance. Full geotechnical test results are contained in Appendix 6.

3.5.2 Moisture Condition Value

Moisture Condition Value (MCV) was determined for 5 No. samples of glacial till.

Sample	Sample Depth (m bgl)	Sample Depth (m AOD)	Moisture Content (%)	mcv
TP02	0.60	94.03	27	6.3
TP15	0.50	88.90	26	5.8
TP21	0.50	94.73	21	6.1
WS14	0.35 – 0.90	89.94 – 89.39	24	5.8
WS18	0.35 – 0.90	92.76 – 92.21	22	6.4

Full geotechnical test results are contained in Appendix 6.

3.5.3 Particle Size Distribution and Sedimentation Tests

Particle size distribution (PSD) tests were undertaken on 4 No. samples taken from varying depths:

Sample	Sample Depth (m bgl)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
TP09	1.40	0	56	35	9
TP21	2.40	1	11	69	19
TP36	1.60	2	25	41	32
TP41	1.30	0	63	29	8
WS21	0.80 – 1.50	4	40	39	17

Full geotechnical test results are contained in Appendix 6.

3.6 **Environmental Laboratory Test Results**

The findings of the chemical test results, summarised below, will be assessed against generic assessment criteria (GAC) for the purposes of screening allowable concentrations in comparison to the measured site concentrations. The GAC are defined based on the critical receptors identified at the site. Receptors are considered in relation to:

- Human health receptors (e.g. end-users, construction workers and the general public) via measured solid concentrations, and;

Additional receptors may be relevant dependant on the site e.g. flora/fauna, water, buried concrete.

The GAC adopted for assessment of soils in relation to Human Health are based on published LQM/CIEH S4ULs (2015) for those compounds for which published criteria are available for varying scenarios (residential, commercial, allotment, public open space). In the absence of LQM/CIEH S4ULs (2015) the following GAC defining documents are adopted - CL:AIRE Soil GAC for Human Health Assessment (2010) and Category 4 Screening Levels (C4SLs) (2014).

The primary risk to human receptors from free cyanide in soils is an acute risk (i.e. a single dose could have a lethal affect as opposed to adverse effects from cumulative intake (chronic affect). There is no current UK guidance available for calculating acute risks from free cyanide, therefore an in-house methodology has been used to derive an acute GAC of 60 mg/kg for all exposure scenarios. The value is given for Free or Easily Liberatable Cyanide but should be used to assess Total Cyanide in the absence of cyanide speciation. In cases where the Total Cyanide exceeds the GAC then analysis for Free or Easily Liberatable Cyanide should be completed.

GACs / Tier 1s for waters must be selected to assess potential risks to the identified environmental receptors. There are numerous UK and European guidelines for waters based on the site situation and different receptors. GACs utilised include - The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2009 (Part 7:Groundwater Threshold Values), UK Drinking Water Standards (2000), Environmental Quality Standards, World Health Organisation concentrations, Environment Agency guidance concentrations and United States Environmental Protection Agency – Region 9 GACs.

3.6.1 Solid Samples

Summary tables indicating the results, assessed against their relevant GACs (residential with home grown produce land use scenario), are noted below for the following:

- 10 No. topsoil samples

- 11 No. natural subsoil (glacial till) samples (including 1 No. organic clay sample)
- 3 No. made ground samples.

Solid Contamination Results – Topsoil					
Determinand	No. of Samples	Range of Results	Mean	GAC	Exceeded Allowable
Inorganics, Carbon and Asbestos					
Asbestos Quantification (%)	6	None Detected		-	0
Water Soluble Sulphate as SO ₄ 2:1 Extract (mg/l)	6	7.2-19.7	10.7	-	-
Soil Organic Matter (%)	6	2.6-5.4	3.8	-	-
pH	6	6.0-6.8	6.2	-	-
Cyanide, Total	6	<1	1	60 ²	0
Cyanide, Free	6	<1	1	60 ²	0
Nitrate as NO ₃ 2:1 water soluble (mg/l)	6	<5.0	5.0	-	-
Boron (hot water soluble)	6	0.5-1.1	0.9	290	0
Metals and Semi-Metals					
Arsenic	6	9.1-25	18.2	37	0
Barium	6	95-130	114.2	-	-
Beryllium	6	0.76-1.3	1.1	1.7	0
Cadmium	6	<0.2	0.2	11	0
Chromium (hexavalent)	6	<1.2	1.2	6	0
Chromium	6	20-26	23.3	910	0
Copper	6	27-95	54.7	2400	0
Lead	6	32-110	75.2	200 ¹	0
Mercury	6	<0.3-0.3	0.3	1.2	0
Nickel	6	18-27	23.5	130	0
Selenium	6	<1.0	1.0	250	0
Vanadium	6	27-48	38.3	410	0
Zinc	6	38-110	82.8	3700	0
BTEX and MTBE					
6 No. samples were tested for Benzene, Toluene, Ethylbenzene, p-, m- and o-Xylene and MTBE. All concentrations were below their respective limits of detection (1.0µg/kg)					
Speciated Total Petroleum Hydrocarbons					
TPH-CWG - Aliphatic >EC5 - EC6	6	<0.001	0.001	78	0
TPH-CWG - Aliphatic >EC6 - EC8	6	<0.001	0.001	230	0
TPH-CWG - Aliphatic >EC8 - EC10	6	<0.001	0.001	65	0
TPH-CWG - Aliphatic >EC10 - EC12	6	<1.0-4.5	1.6	330	0
TPH-CWG - Aliphatic >EC12 - EC16	6	<2.0-8.2	3.0	2400	0
TPH-CWG - Aliphatic >EC16 - EC21	6	<8.0	8.0	92000	0
TPH-CWG - Aliphatic >EC21 - EC35	6	<8.0-15	9.2		
TPH-CWG - Aliphatic > EC35 - EC44	6	<8.4	8.4	92000	0
TPH-CWG - Aliphatic (EC5 - EC35)	6	<10-34	14.0	-	-
TPH-CWG - Aliphatic (EC5 - EC44)	6	<10-34	14.0	-	-
TPH-CWG - Aromatic >EC5 - EC7	6	<0.001	0.001	140	0
TPH-CWG - Aromatic >EC7 - EC8	6	<0.001	0.001	290	0
TPH-CWG - Aromatic >EC8 - EC10	6	<0.001	0.001	83	0
TPH-CWG - Aromatic >EC10 - EC12	6	<1.0	1.0	180	0
TPH-CWG - Aromatic >EC12 - EC16	6	<2.0-14	5.1	330	0
TPH-CWG - Aromatic >EC16 - EC21	6	<10-20	11.7	540	0
TPH-CWG - Aromatic >EC21 - EC35	6	<10-38	14.8	1500	0
TPH-CWG - Aromatic > EC35 - EC44	6	<8.4	8.4	1500	0
TPH-CWG - Aromatic (EC5 - EC35)	6	<10-71	23.3	-	-
TPH-CWG - Aromatic (EC5 - EC44)	6	<10-71	23.3	-	-
Polynuclear Aromatic Hydrocarbons (PAHs)					

Naphthalene	6	<0.5-0.38	0.15	5.6	0
Acenaphthylene	6	<0.05	0.05	420	0
Acenaphthene	6	<0.05-0.87	0.25	510	0
Fluorene	6	<0.05-0.64	0.19	400	0
Phenanthrene	6	<0.05-5.4	1.59	220	0
Anthracene	6	<0.05-1.3	0.38	5400	0
Fluoranthene	6	<0.05-5.8	1.73	560	0
Pyrene	6	<0.05-5.2	1.56	1200	0
Benzo(a)anthracene	6	<0.05-2.5	0.77	11	0
Chrysene	6	<0.05-2.4	0.78	22	0
Benzo(b)fluoranthene	6	<0.05-2.5	0.81	3.3	0
Benzo(k)fluoranthene	6	<0.05-0.87	0.29	93	0
Benzo(a)pyrene	6	<0.05-2.1	0.67	2.7	0
Indeno(1,2,3-cd)pyrene	6	<0.05-0.9	0.27	36	0
Dibenz(a,h)anthracene	6	<0.05-0.26	0.09	0.28	0
Benzo(ghi)perylene	6	<0.05-0.97	0.30	340	0
Total PAH (Sum of USEPA 16)	6	<0.80-32.1	9.6	-	-
Pesticides and Acid Herbicides					
4 No. samples were tested for a wide range of pesticides and acid herbicides. All were below their respective detection limits.					

Generic Assessment Criteria Used: LQM/CIEH S4ULs for Human Health Risk Assessment (3rd edition, 2015), unless stated:

- 1) Category 4 Screening Levels (March 2014)
- 2) In-house screening value has been used as no GAC methodology currently exists

Note 1 – Units are in mg/kg unless stated.

Note 2 – Assumed 2.5% SOM (conservative value closest to arithmetic mean of soil organic matter %)

Note 3 – Detection limit values used to calculate arithmetic mean

Note 4 – All GAC used relate to the **residential with plant uptake land use scenario**

Solid Contamination Results – Glacial Till					
Determinand	No. of Samples	Range of Results	Mean	GAC	Exceeded Allowable
Inorganics, Carbon and Asbestos					
Asbestos Quantification (%)	2	Not Detected		-	0
Water Soluble Sulphate as SO ₄ 2:1 Extract (mg/l)	11	6.2-25.4	12.7	-	-
Soil Organic Matter (%)	11	0.6-1.6	1.0	-	-
pH	11	5.6-8.2	7.1	-	-
Cyanide, Total	11	<1	1	60 ²	0
Cyanide, Free	11	<1	1	60 ²	0
Nitrate as NO ₃ 2:1 water soluble (mg/l)	11	<5.0-12	6.0	-	-
Boron (hot water soluble)	11	0.4-0.9	0.6	290	0
Metals and Semi-Metals					
Arsenic	11	4.0-9.4	7.3	37	0
Barium	11	62-160	114.8	-	-
Beryllium	11	0.62-1.1	0.9	1.7	0
Cadmium	11	<0.2	0.2	11	0
Chromium (hexavalent)	11	<1.2	1.2	6	0
Chromium	11	17-28	23.6	910	0
Copper	11	16-36	28.7	2400	0
Lead	11	11-18	14.1	200 ¹	0
Mercury	11	<0.3	0.3	1.2	0
Nickel	11	19-45	29.5	130	0
Selenium	11	<1.0	1.0	250	0
Vanadium	11	22-31	26.5	410	0
Zinc	11	38-80	53.0	3700	0
Total Petroleum Hydrocarbon (TPH) Screening					
11 No. samples were tested for TPH in the following bands: C6-C10, C10-C40, C6-C40, C10-C25 and C25-C40. All were below their respective detection limits.					
Polynuclear Aromatic Hydrocarbons (PAHs)					

All PAHs were below Detection limit with the Exception of:					
Phenanthrene	11	<0.05-0.27	0.07	95	0
Fluoranthene	11	<0.05-1	0.14	280	0
Pyrene	11	<0.05-0.89	0.13	620	0
Benzo(a)anthracene	11	<0.05-0.42	0.08	7.2	0
Chrysene	11	<0.05-0.44	0.09	15	0
Benzo(b)fluoranthene	11	<0.05-0.45	0.09	2.6	0
Benzo(k)fluoranthene	11	<0.05-0.2	0.06	77	0
Benzo(a)pyrene	11	<0.05-0.37	0.08	2.2	0
Total PAH (Sum of USEPA 16)	11	<0.80-4.04	1.09	-	-

Generic Assessment Criteria Used: LQM/CIEH S4ULs for Human Health Risk Assessment (3rd edition, 2015), unless stated:

- 1) Category 4 Screening Levels (March 2014)
- 2) In-house screening value has been used as no GAC methodology currently exists

Note 1 – Units are in mg/kg unless stated.

Note 2 – Assumed 1.0% SOM (arithmetic mean of soil organic matter %)

Note 3 – Detection limit values used to calculate arithmetic mean

Note 4 – All GAC used relate to the **residential with plant uptake land use scenario**

Solid Contamination Results – Made Ground					
Determinand	No. of Samples	Range of Results	Mean	GAC	Exceeded Allowable
Inorganics, Carbon and Asbestos					
Asbestos Quantification (%)	3	None Detected		-	0
Water Soluble Sulphate as SO ₄ 2:1 Extract (mg/l)	3	22.6-61.7	41.3	-	-
Soil Organic Matter (%)	3	5.2-9.8	6.9	-	-
pH	3	6.1-7.7	6.9	-	-
Cyanide, Total	3	<1	1	60 ²	0
Cyanide, Free	3	<1	1	60 ²	0
Nitrate as NO ₃ 2:1 water soluble (mg/l)	3	<5.0-13	7.7	-	-
Boron (hot water soluble)	3	0.8-1.7	1.13	290	0
Metals and Semi-Metals					
Arsenic	3	20-120	56	37	1
Barium	3	120-610	297	-	-
Beryllium	3	1.1-5.3	2.60	1.7	1
Cadmium	3	<0.2	0.2	11	0
Chromium (hexavalent)	3	<1.2	1.2	6	0
Chromium	3	20-31	24	910	0
Copper	3	64-470	201	2400	0
Lead	3	110-1400	543	200 ¹	0
Mercury	3	0.5-0.5	0.37	1.2	0
Nickel	3	28-97	52	130	0
Selenium	3	<1.0	1.0	250	0
Vanadium	3	35-170	82	410	0
Zinc	3	100-390	200	3700	0
Total Petroleum Hydrocarbons					
Petroleum Range Organics C6-C10	3	<0.1	0.1	-	-
TPH C10-C40	3	<10-42	21	-	-
TPH C6-C10	3	<0.1	0.1	-	-
TPH C6-C40	3	<10-42	21	-	-
TPH C10-C25	3	<10-28	16	-	-
TPH C25-C40	3	<10-14	11	-	-
Polynuclear Aromatic Hydrocarbons (PAHs)					
Naphthalene	3	<0.05-1.1	0.51	13	0
Acenaphthylene	3	<0.05	0.05	920	0
Acenaphthene	3	<0.05	0.05	1100	0
Fluorene	3	<0.05	0.05	860	0

Phenanthrene	3	<0.05-0.97	0.56	440	0
Anthracene	3	<0.05-0.21	0.14	11000	0
Fluoranthene	3	<0.05-1.2	0.75	890	0
Pyrene	3	<0.05-1.1	0.72	2000	0
Benzo(a)anthracene	3	<0.05-0.88	0.50	13	0
Chrysene	3	<0.05-0.64	0.42	27	0
Benzo(b)fluoranthene	3	<0.05-0.75	0.51	3.7	0
Benzo(k)fluoranthene	3	<0.05-0.3	0.21	100	0
Benzo(a)pyrene	3	<0.05-0.62	0.43	3.0	0
Indeno(1,2,3-cd)pyrene	3	<0.05-0.32	0.22	41	0
Dibenz(a,h)anthracene	3	<0.05	0.05	0.3	0
Benzo(ghi)perylene	3	<0.05-0.33	0.23	350	0
Total PAH (Sum of USEPA 16)	3	<0.80-8.37	5.29	-	-

Generic Assessment Criteria Used: LQM/CIEH S4ULs for Human Health Risk Assessment (3rd edition, 2015), unless stated:

- 1) Category 4 Screening Levels (March 2014)
- 2) In-house screening value has been used as no GAC methodology currently exists

Note 1 – Units are in mg/kg unless stated.

Note 2 – Assumed 6% SOM (conservative value closest to arithmetic mean of soil organic matter %)

Note 3 – Detection limit values used to calculate arithmetic mean

Note 4 – All GAC used relate to the **residential with plant uptake land use scenario**

Full chemical test results are contained in Appendix 7.

As shown in the tables above, no exceedances have been detected in the topsoil or the natural glacial till. Exceedances of arsenic and beryllium have been detected in 1 No. made ground sample – WS21 @ 0.30-0.80m bgl. No exceedances were detected in the other 2 No. made ground samples.

3.7 Ground Gas Monitoring

Following the findings of the *IGE Consulting Phase 1 Geo-Environmental Investigation Report* (March 2021), 8 No. gas monitoring wells were installed in order to allow monitoring and subsequent ground gas risk assessment to be undertaken for a period of 6 visits. The response zones for each of the monitoring wells are detailed in Section 2.3.

All 6 No. ground gas monitoring visits have been completed. The following results were recorded:

Gas Monitoring Well	Steady O ₂ Conc. Range (%)	Peak CO ₂ Conc. Range (%)	Peak CH ₄ Conc. Range (%)	Peak H ₂ S Conc. Range (ppm)	Peak PID Conc. Range (ppm)	Atmospheric Pressure Range(mbar)	Steady Gas Flow Range (l/hr)
WS02	18.0 – 20.6	0.5 – 2.0	0.0	0	0.1 – 2.3	985 – 1020	-2.0 – 0
WS03	17.9 – 20.3	0.5 – 2.2	0.0	0	0.0 – 3.6	985 – 1020	0.0
WS06	18.5 – 20.5	0.2 – 2.1	0.0	0	0.0 – 3.4	985 – 1021	0.0
WS07	18.3 – 20.6	0.3 – 2.1	0.0	0	0.1 – 3.5	985 – 1020	-0.6 - 0
WS11	19.5 – 20.4	0.5 – 2.1	0.0	0	0.3 – 1.7	985 – 1021	0.0

WS14A	19.7 – 20.6	0.1 – 2.0	0.0	0	0.2 – 4.6	985 – 1020	-0.6 – 0
WS18	6.4 – 19.8	0.1 – 4.3	0.0	0	0.0 – 1.2	985 – 1020	-0.3 – 2.5
WS21	19.5 – 20.6	0.2 – 1.2	0.0	0	0.0 – 0.5	984 – 1020	0.0

Ground gas monitoring was undertaken utilising a GFM 4300 gas analyser.

The ground gas monitoring results are included in Appendix 8.

3.8 Groundwater Depth monitoring

The above wells were also installed for the purposes of groundwater depth monitoring. 6 No. groundwater monitoring visits have been undertaken. The following results were recorded:

Groundwater Monitoring Well	Response Zone (m bgl)	Water Level Range (m bgl)	Remarks
WS02	1.00 – 4.00	-0.09 – 0.58	-0.09m as raised well installed and groundwater level above ground level, artesian groundwater conditions encountered.
WS03	1.00 – 4.00	0.43 – 1.34	
WS06	1.00 – 4.00	0.74 – 1.01	
WS07	1.00 – 4.00	0.20 – 0.55	
WS11	1.00 – 4.00	0.72 – 0.91	
WS14A	1.00 – 4.00	0.25 – 0.65	
WS18	1.00 – 4.00	Dry	
WS21	1.00 – 3.00	0.37 – 0.60	

The groundwater monitoring results are included with the gas monitoring results in Appendix 8.

3.9 Potable Water Supply

A United Utilities Risk Assessment (UURA) has been undertaken for the site, based on the chemical laboratory testing results contained within Appendix 7. The UURA is contained in Appendix 9 and PE pipe is recommended for the site.

4.0 ENVIRONMENTAL CONCLUSIONS

4.1 Assessment of Environmental Results

Soil sample analyses have assessed the presence of contaminants on a spatial basis, and the concentrations at which they occur at targeted exploratory hole locations – i.e. recorded infilled ponds (TP26 and TP36) and unrecorded infilled ponds discovered during the site investigation pond (TP07, TP40 and WS21). The location of the demolished historic farm buildings could not be targeted due to the presence of live services in the area.

No GAC exceedances for the '*residential with plant uptake*' land use scenario were recorded for any of the natural samples (topsoil and glacial till) sent for laboratory chemical testing. No herbicides or pesticides were detected above detection limits within the topsoil. No asbestos was detected in any of the samples tested. Therefore, the existing subsoil and topsoil are indicated to be suitable for re-use within the proposed development based upon the chemical testing undertaken, however, further testing will be necessary at a greater frequency on a phase by phase basis as topsoil is brought into reuse.

Of the 3 No. made ground samples tested, two of these contained no GAC exceedances, including a sample from the targeted infilled pond.

However, made ground sample WS21 @ 0.30-0.80m bgl, from within the infilled pond along the northern boundary of Phase 4, contained exceedances of arsenic and beryllium.

4.2 Revised Conceptual Models

The original conceptual models produced in the *IGE Consulting Phase 1 Geo-Environmental Investigation Report* have been revised / updated using the findings from the Geo-Environmental Ground Investigation.

4.2.1 Human Health Risk Assessment

The possible sources of on-site contamination identified within the Phase 1 report include:

- On-site made ground (in localised areas including infilled ponds)
- Agricultural use (herbicides and pesticides)
- Demolished buildings

The human health receptors identified within the Phase 1 report include:

- End users (residents – ‘residential with home grown produce’ land use scenario).
- Construction workers.
- The general public and adjacent site users.

The human health pathways identified within the Phase 1 report include:

- Ingestion of soil directly (including on home grown produce) and indoor dust*;
- Inhalation of soil dust (indoor and outdoor);
- Dermal contact with soil (indoor and outdoor);
- Inhalation of soil vapours (indoor and outdoor);
- Oral background;
- Inhalation background.

** Treated as one pathway*

Revised Conceptual Model for Human Health Risk Assessment

No human health GAC exceedances were recorded within the natural site soils on-site for the residential with plant uptake land use scenario, nor within 2 of the 3 made ground samples from the infilled ponds.

However, arsenic and beryllium were detected within the made ground in the unrecorded infilled pond in development phase 4 at concentrations above their respective human health GACs. Consequently, a pollutant linkage is present if soft landscaping or private gardens are located in this area, as the end user may come into contact with site soils in these areas of the proposed development.

Therefore, it is recommended to undertake remediation to break contaminative linkages in the location of the infilled pond in development phase 4 only - either install a clean cover system in the soft landscaping and gardens located in the infilled pond or excavate the unacceptable soils.

It is understood that the infilled ponds present in development phases 4 and 5 may be excavated for geotechnical purposes. On this basis, this will constitute source removal therefore the contaminative source will be removed and no remedial measures necessary subject to validation of imported material.

As the location of the demolished historic farm buildings could not be targeted due to the presence of live services in the area, further targeted site investigation should be undertaken in this area following service clearance during the detailed design phase.

No other visual or olfactory evidence of contamination was found.

Based on the above, the site is considered to pose a **very low risk** to human health of site occupants, the general public and construction workers, except in the unrecorded infilled pond area within development phase 4, which will require remediation as described above. Any increase in risk to construction workers associated with acute interaction with soils can be mitigated with appropriate PPE and health and safety procedures.

This conclusion is dependent upon finalised levels and will need to be reassessed following receipt of a detailed development plan.

4.2.2 Ground Gas Risk Assessment

Potential ground gas sources identified within the Phase 1 report include:

- Made ground (if present in localised areas)
- Peat
- Possible coal mine workings

Potential ground gas pathways identified within the Phase 1 report include:

- Preferential migration along foundations, service ducts / trenches

- Ingress through wall cavities and floors and accumulation
- Inhalation of ground gas

Potential ground gas receptors identified within the Phase 1 report include:

- End users, and to a lesser extent, site workers, if confined spaces are present in which gases are able to accumulate
- Building and structures

Revised Conceptual Model for Ground Gas Risk Assessment

Based on the findings of the site investigation works the conceptual model has been updated as follows:

Possible shallow coal workings can be discounted as a significant ground gas source as they are deemed unlikely to be present. The intrusive site investigation works have also confirmed that the site is underlain by low permeability cohesive superficial deposits which will significantly reduce migration of any possible ground gases from the below shallow coal seams.

No significant made ground or peat deposits were recorded on-site, however, soft organic clay with gravel to cobble sized inclusions of peat were recorded within the infilled ponds (possible made ground) along the northern and southern boundaries. Chemical testing undertaken on 3 No. samples of this material recorded soil organic matter contents of between 5.2% and 9.8%, which isn't deemed to be high enough to be considered a significant ground gas source. The ground gas monitoring results concur with this as no methane was recorded above detection limit (0.1% v/v) in the ground gas monitoring wells installed adjacent to the infilled ponds (WS14A and WS21). Furthermore, only 2.0% and 1.2% (v/v) of carbon dioxide were recorded in WS14A and WS21. Consequently, made ground and peat deposits, including within the infilled ponds, are not deemed to be significant ground gas sources.

The ground gas conceptual model and the results of the 6 No. monitoring visits which have been undertaken to date have been assessed in accordance with BS 8485 (2015) + A1 (2019). The characteristic Gas Screening Value (GSV) is calculated by dividing the maximum methane or carbon dioxide concentration by 100 and

multiplying by the maximum steady flow rate recorded at the same monitoring point (the instrument detection limit of 0.1 l/hr is utilised when below detection limit flow rates are recorded). If required, the worst case GSV can be calculated by dividing the maximum methane or carbon dioxide concentration anywhere on site by 100 and multiplying by the maximum steady flow rate anywhere on site.

Ground gas monitoring has recorded a maximum carbon dioxide peak of 4.3% v/v in WS18. No methane was recorded above detection limits. A single steady flow rate of 2.5l/hr was recorded in WS18 during the second ground gas monitoring visits.

Therefore, the GSV and the worst case GSV for the site can be calculated as $(4.3/100) \times 2.5 = 0.1075$.

Based on the GSV and worst case GSV the site lies within a Characteristic Situation 2 (CS2). However, based on the above conceptual site model and the intrusive works undertaken, no significant ground gas sources have been identified on-site or in close proximity to the site. Therefore, as only marginally elevated concentrations of carbon and a single steady flow was only recorded in WS18 only, the site is deemed to be in-line with a Characteristic Situation 1 (CS1)

Based on the proposed low rise residential development (Type A buildings), no ground gas protection measures are deemed necessary in-line with BS 8485 (2015) + A1 (2019).

Radon

The Indicative Atlas of Radon in England and Wales produced by the Health Protection Agency and British Geological Survey indicates that the site lies within a lower probability area less than 1% of homes are above the action level. Consequently, BR211 (2015) indicates that no radon protection measures are necessary in the construction of new dwellings or extensions.

4.2.3 Controlled Waters Risk Assessment

The possible sources of on-site contamination identified within the Phase 1 report include:

- On-site made ground (in localised areas including infilled ponds)
- Agricultural use (herbicides and pesticides)

The controlled water receptors identified within the Phase 1 report include:

- Groundwater contained within the underlying Secondary Undifferentiated Aquifer within the superficial deposits and the Secondary A Aquifer within the bedrock (unknown depth).
- Surface Water – Pennington brook and on-site ponds.

The controlled waters pathways identified within the Phase 1 report include:

- Vertical migration along current and future foundations and pooling at base / beneath foundations.
- Vertical migration through granular made ground and possible granular natural bands in natural cohesive deposits.
- Lateral migration along low permeability made ground and / or natural cohesive deposits and pooling at relative low points.
- Lateral migration along historic drainage.
- Negligible infiltration through low-permeability natural cohesive deposits.
- Migration along cracks and fissures in bedrock.
- Migration along groundwater flow.
- Overland flow

Revised Conceptual Model for Controlled Waters Risk Assessment

Based on the findings of the site investigation works, the conceptual site model has been updated as follows:

No elevated concentrations of determinands have been identified except in the location of the unrecorded infilled pond, however, the metals detected are not readily mobile and are not present at concentrations which would give rise to a contaminant plume in groundwater. No herbicides and pesticides have been detected. Natural cohesive soils are present across the site acting as an aquitard, and the proposed development will lead to an increase in drainage which will reduce infiltration and runoff. Consequently, the risk to controlled waters is deemed **very low** as no contaminative linkages have been identified.

No remedial measures are deemed necessary.

4.2.4 Summary of Conceptual Site Models

No Remedial Works are required for the scheme with exception of localised excavation of infilled materials, however this is subject to finalised layout, proposed levels and further site investigation works once levels and layout are understood – this should include works into the existing railway batter with associated testing and assessment of the materials. No ground gas protection measures are required for the scheme.

Re-use of Site Won Materials

Based on an average thickness of 0.30m, there is anticipated to be c. 41,400m³ of topsoil suitable for re-use, subject to chemical testing. Based on a reuse of 25% a surplus of c.31,000m³ of topsoil will be available across the site. This will require management in line with the water management recommendations on-site and stockpiling.

Furthermore, the on site subsoils are regarded as chemically suitable to be utilised within proposed soft landscaped areas across the site.

5.0 GEOTECHNICAL CONCLUSIONS

5.1 Geotechnical Assessment of Ground Conditions

The site investigation works have revealed that the ground conditions at the site were relatively consistent with variation in strata mainly being present within development phase 4. Generally, across the site, the ground conditions comprised topsoil underlain by cohesive glacial till with the exception of phase 4 where granular glacial till was encountered.



Figure 6 – Development Phase Plan for the site.

The principal strata identified are outlined in further detail below.

5.1.1 Topsoil

Topsoil was recorded in all exploratory holes and was consistent in terms of composition comprising dark brown, clayey SAND with frequent rootlets and occasional gravel.

5.1.2 Glacial Till (Cohesive Clays)

Cohesive glacial till deposits were encountered in the majority of exploratory holes within all 3 No. development phases, comprising firm, orangish brown, slightly sandy, silty CLAY with occasional gravel becoming firm to stiff and gravelly with depth.

15 No. SPT tests were taken in this stratum recording uncorrected N Values of between 4 and 50+ (average 17) and corrected N_{60} values of between 4 – 44+ (average 15) which increased with depth. Utilising the *Stroud and Butler (1975)* correlation between SPT N values and undrained shear strengths the glacial till has recorded approximate shear strengths of 67kN/m^2 at 1.00m bgl, increasing to 126kN/m^2 at 3.00m bgl.

824 No. hand shear vane results were undertaken within the glacial till which recorded shear strengths of between 5kPa and 120+kPa (average 75kPa). A increase in shear strength with depth was recorded within the cohesive glacial till.

9 No. Atterberg tests were undertaken on samples of shallow glacial till (0.50 – 1.40m bgl), which indicated that on average, the glacial till is of low plasticity / volume change potential.

5 No. moisture condition value (MCV) tests were also undertaken on shallow samples of glacial till at the highest topographical points on-site which may require amendments in levels during the earthworks stage of development. The MCV tests recorded mcv values of between 5.8 – 6.4. The typical re-use without modification range is 8 – 12 and subsequently modification may be required for re-use of these clays on-site.

5.1.3 Glacial Till (Granular Deposits)

The majority of the granular glacial till deposits were encountered in development phases 3 and 4 with isolated areas identified in phase 5 as discussed in Section 3.1.3. Granular glacial till deposits typically comprised brown to dark grey SAND and greyish brown, sandy SILT.

Development Phase 3

Within the eastern site section (development phase 3), the granular sand deposits were encountered beneath cohesive clay from depths of 1.90m – 3.00m bgl. The sands in this area were recorded to be medium dense with SPT N Values of 9 – 16 recorded. It is envisaged that, given the depth of the granular deposits in the development phase 3 area, the overlying cohesive clays would be used as a founding strata subject to proposed development levels.

Development Phase 4

Granular glacial till deposits were more variable in the northern site section (development phase 4). Granular deposits would typically lie beneath cohesive clays from depths of 0.55m – 2.70m bgl. Sands encountered were recorded as very loose to loose with SPT N-Values of 4 – 8. Silts were also encountered in trial pits in the northern site section. These deposits are not considered suitable founding strata for traditional strip or trench foundations.

5.1.4 Alluvium

Alluvium was encountered in a localised area in the eastern site section of phase 3 in the vicinity of the Pennington Brook. This typically comprised wet, brown SAND and GRAVEL to a maximum depth of 1.30m to at least 2.30m bgl (at least 88.13m to 86.78m AOD). Given their localised extent, window samples or subsequent density testing was not undertaken within these deposits, however, given multiple collapses when excavating trial pits, the stratum is considered to be loose and not a suitable founding strata for traditional strip or trench foundations.

5.1.5 Organic Clays (Including Infilled Ponds)

Organic clays comprising very soft to soft, grey, sandy, silty CLAY with organic fragments and gravel to cobble sized peat fragments were encountered both associated with suspected infilled ponds in the vicinity of the northern and southern site boundaries (phase 4 and 5) and in 'soft spot' areas identified within the development phase 4 (TP21 and TP09).

Soil organic matter tests undertaken on a sample of the organic stratum recorded a maximum organic matter content of 9.8%, however this is expected to be higher in

pockets of peat. 3 No. SPT tests were taken in this stratum recording corrected N Values of between 0 and 15 (average 6) and corrected N_{60} values of between 0 - 13 (average 6).

85 No. hand shear vane results were undertaken within the organic clays which recorded shear strengths of between 5kPa and 70kPa (average 28kPa). No correlation with strength and depth was observed.

Given this stratum is of a low strength (average <30kPa), traditional strip or trench foundations would not be suitable and given the presence of gravel to cobble sized pockets of peat, the stratum is unsuitable for vibro stone column ground improvement. Subsequently, a piled foundation solution or removal of material would be required in these areas.

5.2 Groundwater

Site investigation works and groundwater monitoring wells indicate shallow water conditions across the site. During hole construction, water strikes were deemed to mostly be attributed to perched water within granular deposits within the glacial till. Water was noted to be under hydrostatic pressure in TP18 which was caused by the overburden of overlying low permeability clays increasing pore pressures within underlying granular deposits.

Groundwater monitoring wells indicate water levels of -0.04m – 1.34m bgl and 1 no. well (WS18) being dry at a depth of at least 4.00m bgl. Artesian conditions were recorded in WS02 with water recorded above ground level in the western site section.

Given the shallow groundwater recorded, where any excavations are to be constructed i.e. for drainage / foundation purposes it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA R97 and allowance for dewatering is made.

Given large proportions of the site were noted to be waterlogged and the presence of existing drainage runs, further water management strategy will be required to prevent issues during earthworks and development. This is discussed in Section 5.3.

5.3 Hydrological Management

Significant areas of standing water were noted during site investigation works and subsequent monitoring visits undertaken in February 2021. The existing site topsoil was noted to be saturated and a shallow groundwater regime was present during monitoring works. Subsequently, a strategy will need to be designed prior to works to mitigate detrimental effect of saturated ground, in particular the abundant cohesive deposits across the site during earthworks and construction activities. This strategy is likely to incorporate leaving the existing topsoil across the site until development is required, rather than a site wide strip, use of surface water management techniques i.e. grips and silt traps and installation of drainage with holding ponds.

Consideration will also be required for the existing hedgerows and associated water drainage runs identified on the topographical survey and during site investigation works. The figure below is an extract of the Indicative Hydrological Features Plan contained in Appendix 2 (SI-07). This shows the approximate areas of waterlogged ground during site investigation works in February 2021 as well as the existing drainage runs and ponds on-site.

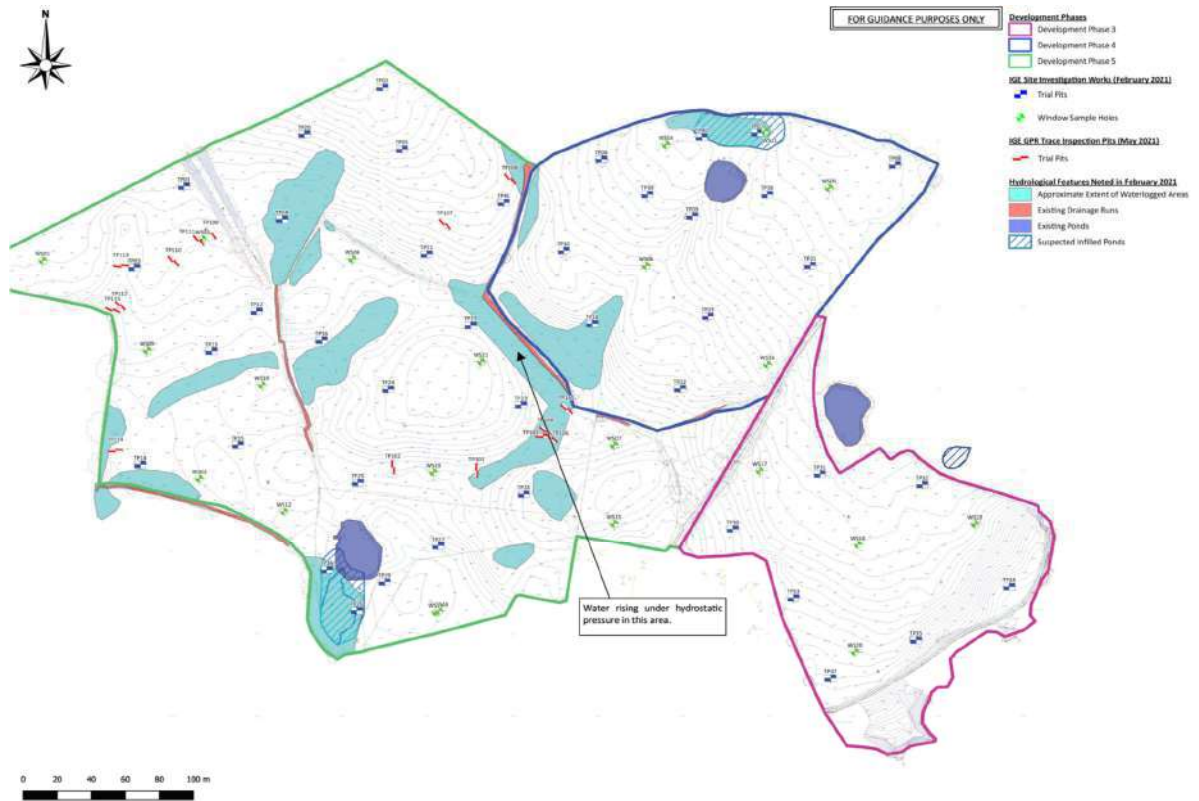


Figure 7 – Extract of the Indicative Hydrological Features Plan.

It is recommended that existing water drainage features are accurately surveyed and measures for their incorporation and improvement are considered within the drainage strategy prior to earthworks.

Given the waterlogged conditions, installation of garden drainage within the proposed garden areas is recommended to prevent standing water issues post-development.

5.4 Foundations

An extract of the indicative Foundation zoning Plan is shown below. The full indicative Foundation Zoning plan is contained in Appendix 2 (SI-06).

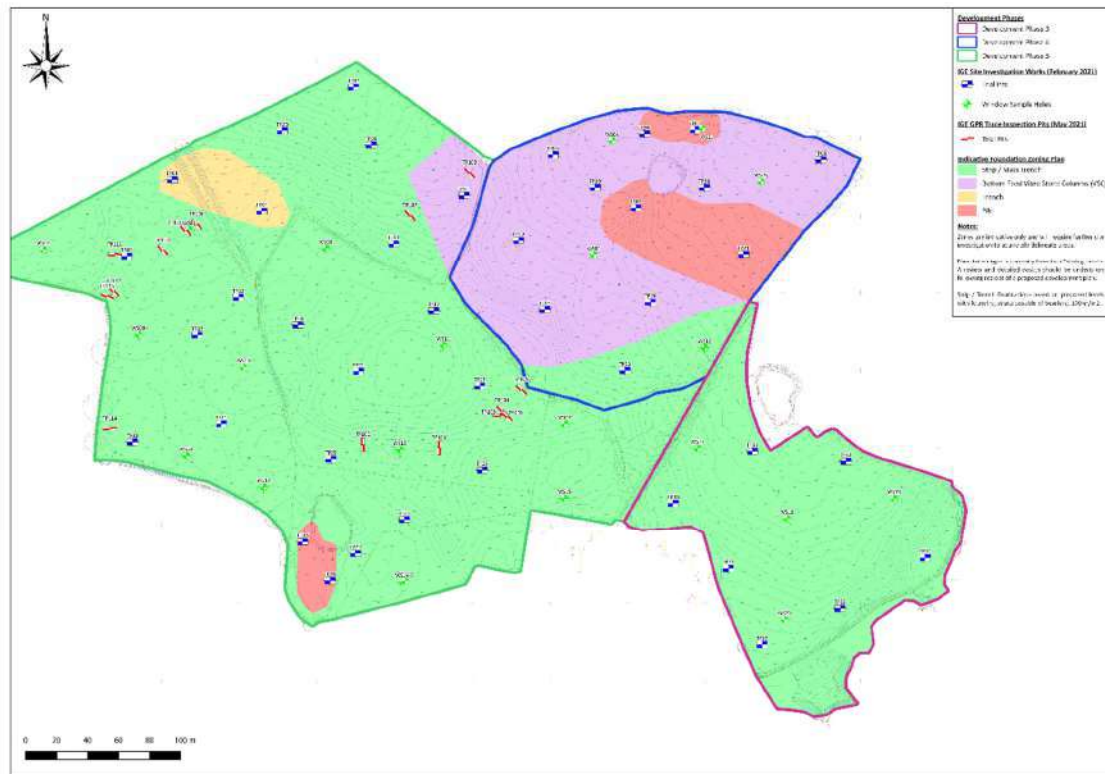


Figure 8 – Extract of the Indicative Foundation Zoning Plan.

Development Phase 3 and 5

Based on existing site levels, it is considered feasible to utilise traditional strip / mass fill trench foundations founding on the cohesive glacial till at depths of between 0.75m and 1.80m bgl with a minimum allowable net bearing pressure of 100kN/m² with differential settlement less than 25mm at least c. 200mm into the glacial till.

To minimise issues with potential differential settlement of the foundation structure, it is recommended that foundations are not constructed upon more than one stratum type, as delineated within the exploratory hole logs. Therefore, care should be taken not to extend the foundations into the underlying granular deposits.

It is recommended that any localised 'soft spot' areas encountered during excavation works should be removed and foundations extended down to suitable formation strata.

Development Phase 4

As discussed in previous sections, ground conditions within development phase 4 were variable with varying proportions and thicknesses of cohesive and granular deposits.

Consequently, traditional strip / trench foundations are not deemed feasible for the majority of Phase 4. Based on the cohesive deposits in the majority of the area having shear strengths in excess of 30kPa, limited organic content (<15% Organic Matter), it is considered feasible to utilise vibro stone columns in the majority of development phase 4, subject to agreement with the ground improvement contractor. However, VSC is not deemed suitable in localised areas (i.e. infilled ponds and where soft organic clays <30kPa have been encountered), which is discussed below.

During earthworks, if any localised areas of unsuitable material is encountered within proposed VSC areas (i.e. soft or organic spots) it should be removed and replaced with engineering fill to a ground improvement specialist specification (refer to section 5.6.2) to allow the use of vibro stone columns. The risk of disturbance / damage through vibration should be considered in respect to the proposed ground improvement foundation solution.

It should be noted that potential localised areas within Phase 4 (i.e. southern area) may be suitable for traditional reinforced strip / trench foundations subject to further works being undertaken following receipt of a proposed development plan including proposed levels.

Infilled Ponds and Organic Clay Soft Spots (Within Phases 4 and 5)

Due to the presence of elevated organic content and low shear strength clays (<30kPa) within the suspected infilled ponds (i.e. TP40) and localised areas (TP09 and TP21), utilising vibro stone columns is not deemed suitable. utilising traditional strip / trench foundations is also not deemed suitable in these areas due to the depth

of the infill material / soft organic clays. Consequently, a piled foundation solution will be required in these areas, as shown on the indicative foundation zoning plan contained in Appendix 2.

At this stage it is not considered economically feasible to excavate the unsuitable material for replacement with appropriate engineered fill to facilitate the use VSC due to the significant volume of unsuitable material (> 6500m³ within infilled ponds only). However, undertaking further works to delineate the extent and depth of the infilled ponds and organic soft spots as well as reassessment following receipt of a proposed development plan including levels may lessen the areas requiring piled foundations. It is likely that additional localised areas of very soft clays (e.g. TP09 and TP21) are present, particularly within the development phase 4 area. Further site investigation works will be required to delineate these areas.

Foundation Conclusions

An indicative foundation zoning plan illustrating the above conclusions is contained in Appendix 2. Following receipt of a detailed development plan including proposed levels and further targeted site investigation, particularly in development phase 4, the above conclusions should be reassessed and a detailed foundation zoning plan produced.

Mature and semi-mature trees were noted along the site boundaries and field divisions. No arboricultural survey had been undertaken at the time of completing the report, we would recommend a tree survey is undertaken and consideration to heave protection measures is made during the final detailed foundation design.

5.5 Floor Slabs

Based on existing site levels, it is envisaged that in line with NHBC Guidance, ground bearing floor slabs will be suitable across the majority of the phase 3 and 5 development areas where strip and trench foundations are utilised. The exception being within areas requiring heave protection.

Suspended slabs will be required for piled and vibro stone column foundations within areas of suspected infilled ponds and the majority of development phase 4 given

>600mm of made ground being present beneath the plots (working platform) in line with NHBC Guidance.

Floor slabs will need reassessment after receipt of proposed development plans and site levels.

5.6 Externals and Earthworks

5.6.1 Highways and Externals

Given the nature of the underlying material (glacial till across the majority of the site) it is envisaged that any soft spots can be re-engineered, therefore the hard-surfaced external works including the access road and pavements may be constructed on proof rolled natural sub grade formations across the site. Following completion of the earthworks, specification below, it is recommended that further CBRs are undertaken for detailed design of the highway / external areas to be finalised.

5.6.2 VSC Engineered Fill Specification

If localised soft spots are encountered within the proposed VSC area, or if further investigation concludes that the infilled pond material could be removed, the following upfill specification is required to permit VSC:

Granular materials and free draining with an upper size limit of 100mm and less than 10% passing the 75 micron sieve test. In addition there shall be less than 20% material finer than 2mm. Particles shall be stable and have a Los Angeles Coefficient (LA Value) not exceeding 30%. The materials should be loosely end tipped and levelled without being specifically compacted. The above also refers to any recently placed or proposed backfill materials.

Any cohesive fill placed must be suitably engineered in place, with moisture contents controlled, according to an appropriate specification (e.g. Department of Transport Specification for Earthworks Series 600 Method 2). This is in order to eradicate any self-weight issues with this newly placed fill. In order to ensure that the newly placed ground is readily penetrable to our normal equipment without the need to pre-bore a

minimum dry density of 95% compaction should be used with a CBR of 5% (not exceeding a CBR of 8%).

It is recommended that a ground improvement contractor is permitted access to inspect earthworks activities to enable satisfaction with the methodology and the works are undertaken in accordance with NHBC guidance.

It is recommended that a temporary working platform is undertaken in line with BRE470 / EC7 with appropriate in-situ testing undertake to validate the installation. The movement / tracking of the VSC rig between plots and access onto site should be considered within the design.

5.6.3 Earthworks

The proposed earthworks and engineering works are to be undertaken to achieve the following key geotechnical outcomes:

- Excavate and remove any ground obstructions and re-engineer to a specified engineering specification appropriate to specific site areas e.g. proposed roads, pavements, soft landscaped areas.
- Undertake appropriate excavation works and suitable backfill to permit the installation by Third Parties of the required drainage and services across the site to the agreed drainage design.

Classification

This Specification should be read in conjunction with the following:

- The Manual of Contract Documents for Highway Works, Volume 1, Specification for Highway Works, Series 600, Earthworks as amended in (November 2005); and,
- Soils for Civil Engineering Purposes (BS1377) 1999.

The contractor should ensure that all earthworks materials comply with Clause 601 of the Specification for Highway Works and shall fall into one of the other of the following general classifications as defined in Table 6/1 of the Specification for Highway Works:

- General granular fill (Class 1),

- General cohesive fill (Class 2), excluding class 2A and 2E,
- Selected granular fill (Class 6).

In addition to any grading requirement the maximum particle size of any fill material shall be no more than two-thirds of the compacted layer thickness except that cobbles having an equivalent diameter of more than 150mm shall not be deposited within the restored surface level unless directed otherwise by the Engineer. Un-burnt colliery spoil, pulverised fuel ash or furnace bottom ash shall not be used as a fill material.

Engineering Specification

The contractor should employ a suitably experienced engineer to be present on site during these earthwork operations to ensure soil suitability, placement, compaction and testing is undertaken in accordance with this specification and to ensure that any unforeseen circumstances, such as adverse weather, do not compromise the earthworks process.

Works should be halted during periods of intermittent or prolonged rainfall to ensure the materials are not placed in a manner that would result in softening of either the formation or the newly placed material. It will be the contractor's responsibility to determine appropriate weather conditions and determine the suitability of works. Particular attention must be given to variable weather conditions when re-engineering clay soils as a moisture content fluctuation (2%+/-) of the tolerable limit will result in unacceptable degree of compaction loss.

Four moisture condition value (MCV) tests were also undertaken on samples of shallow glacial till which recorded MCVs of between 5.8 – 6.4. The typical re-use without modification range is an MCV of 8 to 12, consequently, modification may be required on-site.

It is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA R97. Given the recorded groundwater and perched water, the requirement for temporary works including dewatering is considered likely.

Earthworks Placement Specification

Outside the areas noted for Vibro Compaction detailed in Section 4.4, the below Earthwork Specification should be utilised:

END USE	DETAILS	REQUIREMENT
External Areas - Highways, driveways, drainage runs, backfill behind retaining walls	Site	Method of compaction in line with Department of Transport Specification for Earthworks Series 600 Method 2 to achieve CBR >5%. Formation level for adoptable highways to achieve CBR >15% utilising 450mm diameter plate and in line with local / county highways guidance. Engineering advice to be sort if unachievable / uneconomic.
Soft Landscaping - Private Gardens / Public Open Space	Site	Compacted to achieve <30mm settlement. Subsoil material should not be excessively tracked with plant – should permit surface water drainage.

5.6.4 Stockpile Management

During the course of the development there will also be areas of stockpiled soils intended for use within the proposed gardens. These will have been subjected to off-site testing and approved for use on site. It is imperative that the stockpiles are well managed to avoid inadvertent mixing or depositing of surplus or deleterious materials that would compromise the continued use. We would recommend that the site management reviews the proposed positions for placement of stockpiles and places either fencing or warning signs to ensure compliance.

5.6.5 Export of Materials

Any soils to be removed from site must be classified in accordance with WM3 under the definition of waste and chemically tested to determine their destination, i.e. reuse or landfill. Waste ticket records must also be retained as proof of the export of materials from site.

5.7 **Concrete Classification**

In accordance with BRE Special Digest 1: Concrete in Aggressive Ground (2005), soluble sulphates within the glacial till were recorded within design sulphate levels **DS-1** and subsequently within the Aggressive Chemical Environment for Concrete (ACEC) classification of **AC-1s**.

6.0 RECOMMENDATIONS

- The report is based upon the proposed development plans contained in Appendix 3 and existing site levels, given the anticipated variation in existing and proposed levels it is recommended that all conclusions and recommendations within the report are re-assessed once proposed levels are determined e.g. production of a detailed foundation zoning plan.
- Further site investigation works are required to assess the coal risk on-site and to produce an updated Coal Mining Risk Assessment to assess the risk of potential shallow workings on-site and whether there is a requirement for subsequent remedial works e.g. grouting.
- If any further visual or olfactory evidence of contamination is encountered during earthworks or construction work, then the Local Authority Environmental Health Officer and Environment Agency should be contacted immediately in order to determine appropriate mitigation measures.
- Recommend that the presence and associated constraints of all site services are established – in particular a United Utilities Water Main known to be present at shallow depth across the site.
- No Remedial Works are required for the scheme with exception of localised excavation of infilled materials, however this is subject to finalised layout, proposed levels and further site investigation works once levels and layout are understood.
- Topsoil and subsoil across the site is, based upon initial chemical testing, suitable for re-use within the scheme. It should be noted that a significant quantity of surplus topsoil is likely to be present across the scheme.
- It is recommended that a CCTV survey is undertaken to determine the location / route of the red brick culvert identified along the western boundary of development phase 5.

APPENDIX 1

LIMITATIONS OF INVESTIGATION WORK AND REPORT

LIMITATIONS OF REPORT

This consultancy report was compiled and carried out by IGE Consulting Limited ('IGE') for the client, as defined in the main report (the 'client'), on the basis of a defined programme and scope of works and the terms of a contract between IGE and the client. IGE undertook this with all reasonable skill and care, taking into account the limits of the scope of works required by the client, the prevailing site conditions, the time scale involved and the resources, including financial and manpower resources, agreed between IGE and the client. IGE cannot accept responsibility to any parties whatsoever, following the issue of this report, for any matters arising which may be considered outwith the agreed scope of works.

Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices. This report may not be relied upon, or transferred to, by any other party without the written agreement of its author. If a third party relies on this report, it does so wholly at its own and sole risk and IGE disclaims any liability to such parties.

It is IGE's understanding that this report is to be used for the purpose described in the 'Brief' section of this report. That purpose was a significant factor in determining the scope and the services to be provided. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without IGE's review and advice shall be at the client's sole and own risk.

The information contained in this report is protected by disclosure under Part 3 of the Environmental Information Regulations 2004 pursuant to the provisions of Regulation 12(5) without the consent in writing of a Director of IGE.

This report is a function of the date it was written and should be read in light of any subsequent changes in legislation, statutory requirements and industry practices. Ground conditions can also change over time and further investigations or assessment should be made if there is any significant delay in acting on the findings of this report. The passage of time may result in changes in site conditions, regulatory or other legal

provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of IGE. In the absence of such written advice of IGE, reliance on the report in the future shall be at the client's own and sole risk. Should IGE be requested to review the report in the future, IGE shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between IGE and the client.

The observations and conclusions described in this report are based solely upon the scope of works agreed between the client and IGE. IGE has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report. IGE is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the agreed scope of works. For the avoidance of doubt, this report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of invasive species (e.g. Japanese Knotweed). It is recommended that the client appoints a specialist in this subject to carry out a detailed inspection / survey of the site if its presence is suspected. Where mention has been made to the identification of asbestos or asbestos-containing materials this is for indicative purposes only and does not constitute or replace full and proper surveys.

LIMITATIONS OF INVESTIGATION WORK

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions can also be variable and as investigation excavations only allow examination of the ground at discrete locations, the potential exists for ground conditions to be encountered which are different to those considered in this report. The explored extent of the site area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site.

In addition, chemical analysis was carried out for a limited number of parameters, based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Exploratory Holes

Where exploratory holes have been carried out as part of this investigation, the spacing has been determined to provide a reasonable indication of the general ground conditions across the site, but the number has ultimately been limited by commercial constraints. The findings of the exploratory holes relate specifically to the exploratory hole locations and are no absolute guarantee of the ground conditions between such locations. Due allowance should be made for the possibility of variation in conditions between exploratory hole locations.

Extent of Contamination Testing

The extent of contaminated land testing carried out on samples obtained from the site has been determined in accordance with the latest legal guidance issued by the government to provide, with reasonable certainty, the probable general levels of contamination present on site that could pose a significant hazard to human health or waters. The extent of site investigation works including chemical testing has also been limited by reasonable commercial constraints. Although extensive testing of samples has been carried out, the volume of samples taken for testing are a minute fraction of the total volume of soils and groundwater present on site. Therefore, there is a residual risk that undetected pockets of contamination may be present on site, situated between testing locations.

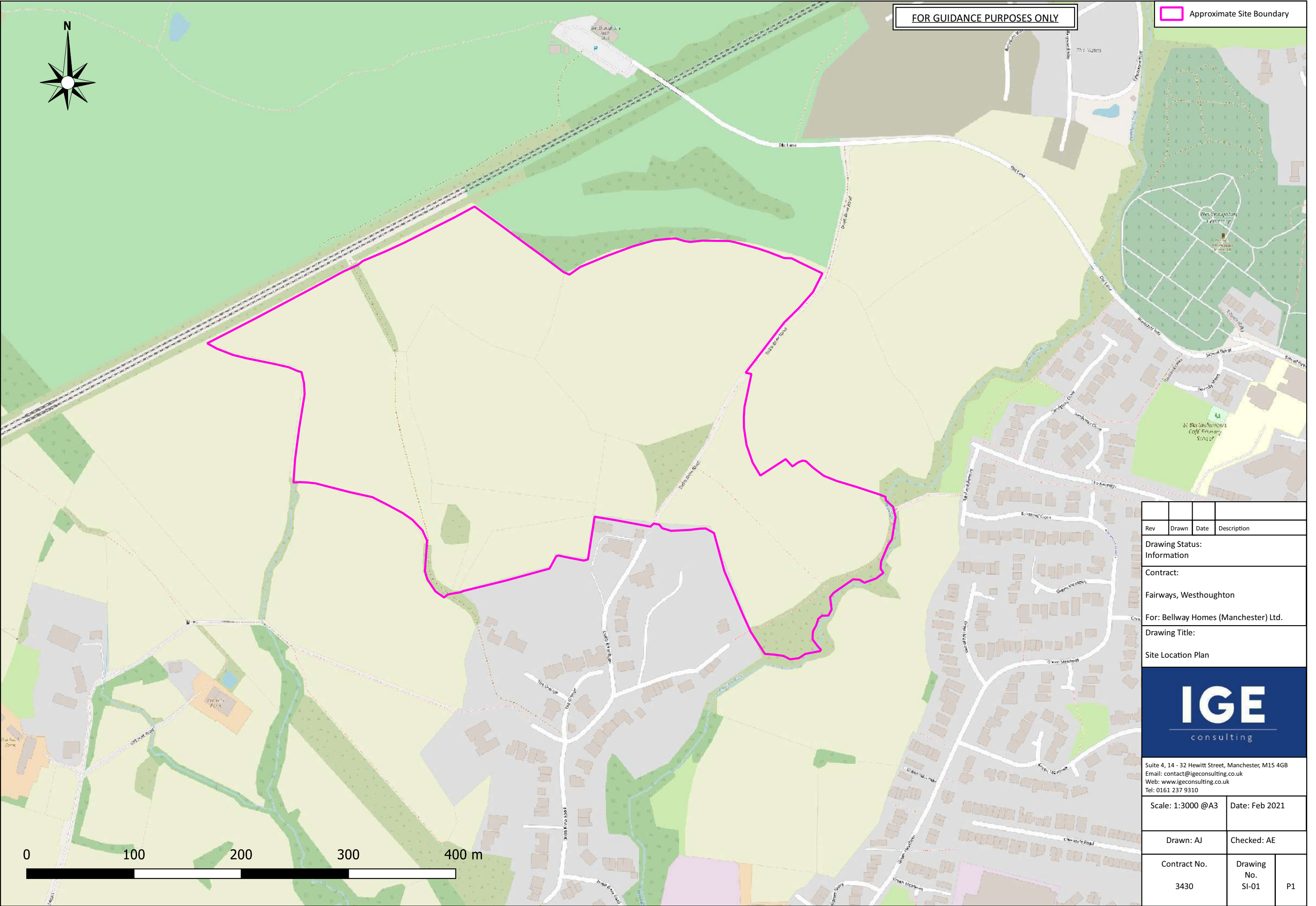
When investigating or developing potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and temporally. The absence of certain ground, ground gas, contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities. The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

Extent of Geo-Environmental Studies

This report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of invasive species e.g. Japanese Knotweed. It is recommended that the Client appoints a specialist in this subject to carry out a detailed inspection / survey of the site if its presence is suspected. Where mention has been made to the identification asbestos or asbestos-containing materials this is for indicative purposes only and does not constitute or replace a full and proper survey. If an Unexploded Ordnance (UXO) report has been obtained within the report, it has been so on the basis of Health and Safety concerns and no assessment has been made other than transcribing the recommendations of the sub-contractor contained within the report. In terms of a potential contaminative source, unless ordnance has been manufactured / stored on site, UXOs will only be determined as a contaminative source following a positive identification on site.

APPENDIX 2

FIGURES AND DRAWINGS



FOR GUIDANCE PURPOSES ONLY

Approximate Site Boundary

Rev	Drawn	Date	Description
-----	-------	------	-------------

Drawing Status:
Information

Contract:

Fairways, Westhoughton

For: Bellway Homes (Manchester) Ltd.

Drawing Title:

Site Location Plan



Suite 4, 14 - 32 Hewitt Street, Manchester, M15 4GB
Email: contact@igeconsulting.co.uk
Web: www.igeconsulting.co.uk
Tel: 0161 237 9310

Scale: 1:3000 @A3 Date: Feb 2021

Drawn: AJ Checked: AE

Contract No.	Drawing No.	
3430	SI-01	P1



FOR GUIDANCE PURPOSES ONLY

Development Phases

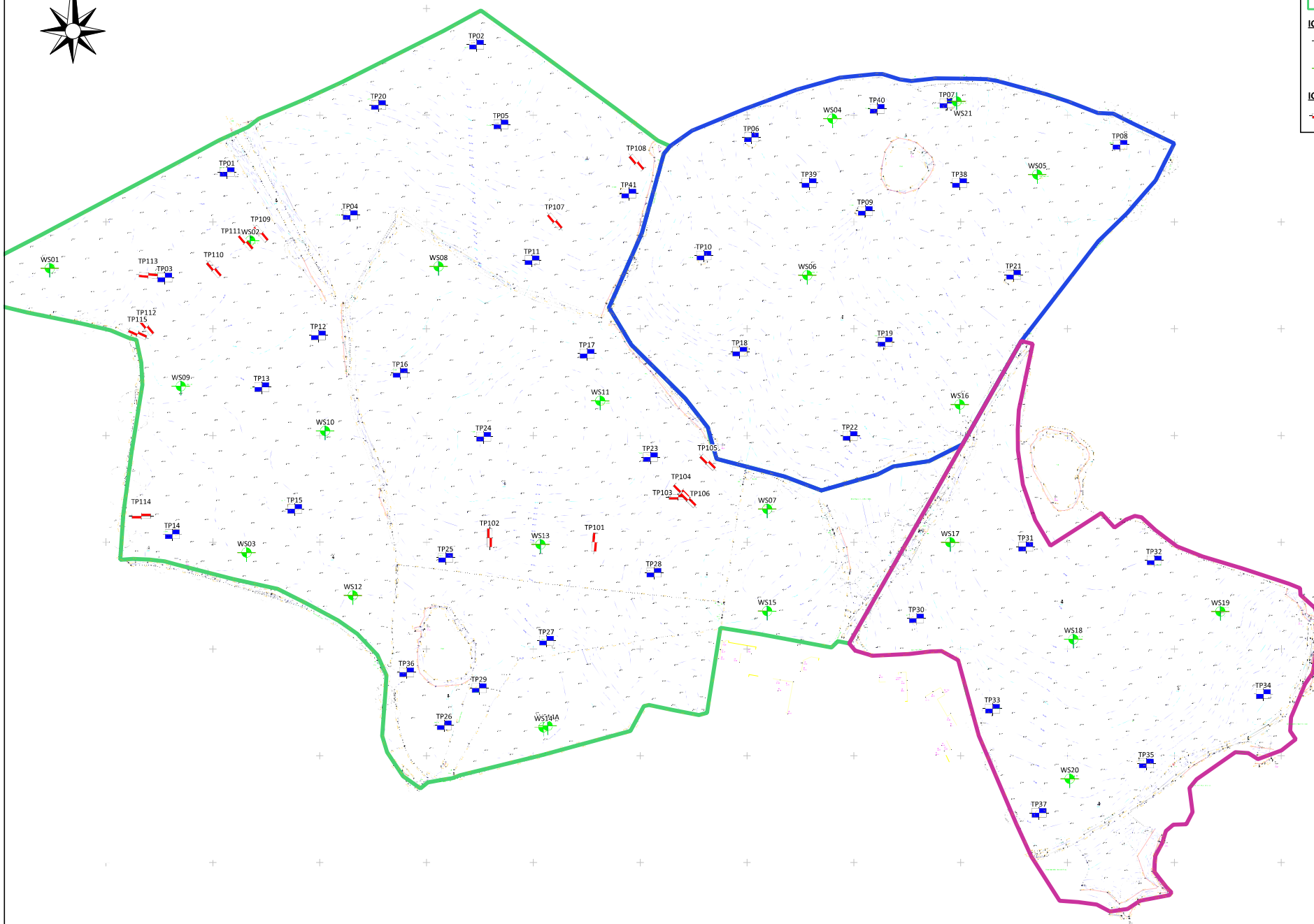
- Development Phase 3
- Development Phase 4
- Development Phase 5

IGE Site Investigation Works (February 2021)

- Trial Pits
- Window Sample Holes

IGE GPR Trace Inspection Pits (May 2021)

- Trial Pits



0 20 40 60 80 100 m



A	AL	05.21	TP101 - 115 added
Rev	Drawn	Date	Description

Drawing Status:
Information

Contract:

Fairways, Westhoughton

For: Bellway Homes (Manchester) Ltd

Drawing Title:

Exploratory Hole Location Plan

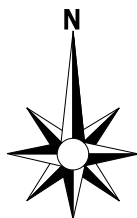
IGE
consulting

Suite 4, 14 - 32 Hewitt Street, Manchester, M15 4GB
Email: contact@igeconsulting.co.uk
Web: www.igeconsulting.co.uk
Tel: 0161 237 9310

Scale: 1:1750 @A3 Date: March 2021

Drawn: AL Checked: AE

Contract No.	Drawing No.	P1
3430	SI-05	



Given a thin band of SAND encountered between 1.10m - 1.60m in this approximate area, deeper trech foundations are anticipated in this area.

Regrade of raised former bridge will be required with removal of material.

Area of suspected infilled pond.

FOR GUIDANCE PURPOSES ONLY

INDICATIVE ONLY

Development Phases

- Development Phase 3
- Development Phase 4
- Development Phase 5

IGE Site Investigation Works (February 2021)

- Trial Pits
- Window Sample Holes

IGE GPR Trace Inspection Pits (May 2021)

- Trial Pits

Indicative Foundation Zoning Plan

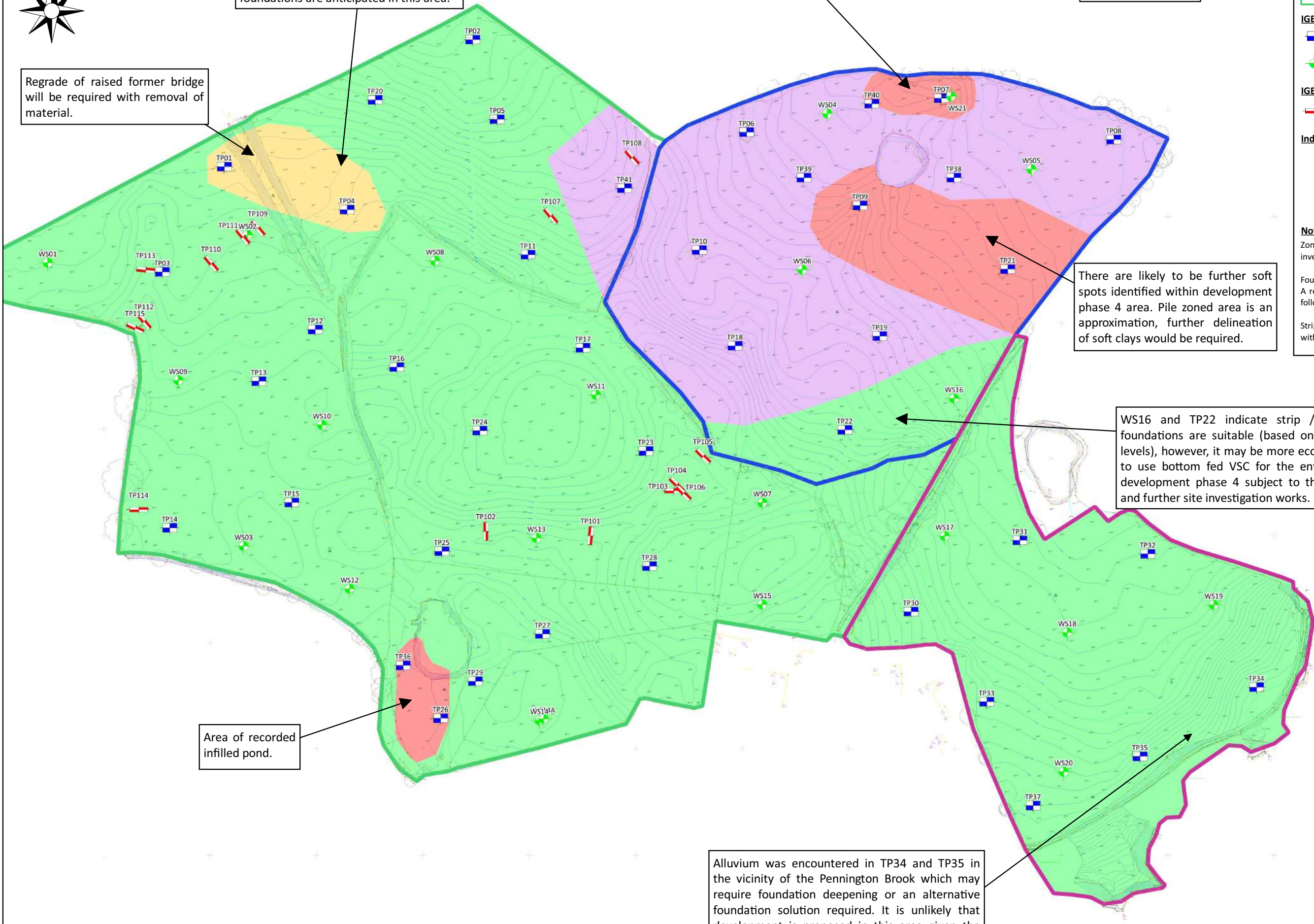
- Strip / Mass Trench
- Bottom Feed Vibro Stone Columns (VSC)
- Trench
- Pile

Notes:

Zones are indicative only and will require further site investigation to accurately delineate areas.

Foundation type is currently based on Existing Levels. A review and detailed design should be undertaken following receipt of a proposed development plan.

Strip / Trench Foundations based on proposed levels with founding strata capable of bearing 100kn/m2.



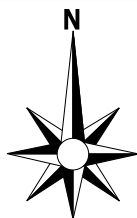
There are likely to be further soft spots identified within development phase 4 area. Pile zoned area is an approximation, further delineation of soft clays would be required.

WS16 and TP22 indicate strip / trench foundations are suitable (based on current levels), however, it may be more economical to use bottom fed VSC for the entirety of development phase 4 subject to the levels and further site investigation works.

Area of recorded infilled pond.

Alluvium was encountered in TP34 and TP35 in the vicinity of the Pennington Brook which may require foundation deepening or an alternative foundation solution required. It is unlikely that development is proposed in this area given the steep slope, existing footpath and brook.

A	AL	05.21	TP101 - 115 added	
Rev	Drawn	Date	Description	
Drawing Status: Information				
Contract: Fairways, Westhoughton For: Bellway Homes (Manchester) Ltd				
Drawing Title: Indicative Foundation Zoning Plan				
IGE consulting				
Suite 4, 14 - 32 Hewitt Street, Manchester, M15 4GB Email: contact@igeconsulting.co.uk Web: www.igeconsulting.co.uk Tel: 0161 237 9310				
Scale: 1:1750 @A3			Date: March 2021	
Drawn: AL			Checked: AE	
Contract No. 3430			Drawing No. SI-06	P1



Regrade of raised former bridge will be required with removal of material.

Given a thin band of SAND encountered between 1.10m - 1.60m in this approximate area, deeper trench foundations are anticipated in this area.

Area of suspected infilled pond.

FOR GUIDANCE PURPOSES ONLY

INDICATIVE ONLY

Development Phases

- Development Phase 3
- Development Phase 4
- Development Phase 5

IGE Site Investigation Works (February 2021)

- Trial Pits
- Window Sample Holes

IGE GPR Trace Inspection Pits (May 2021)

- Trial Pits

Indicative Foundation Zoning Plan

- Strip / Mass Trench
- Bottom Feed Vibro Stone Columns (VSC)
- Trench
- Pile

Notes:

Zones are indicative only and will require further site investigation to accurately delineate areas.

Foundation type is currently based on Existing Levels. A review and detailed design should be undertaken following receipt of a proposed development plan.

Strip / Trench Foundations based on proposed levels with founding strata capable of bearing 100kn/m2.

There are likely to be further soft spots identified within development phase 4 area. Pile zoned area is an approximation, further delineation of soft clays would be required.

WS16 and TP22 indicate strip / trench foundations are suitable (based on current levels), however, it may be more economical to use bottom fed VSC for the entirety of development phase 4 subject to the levels and further site investigation works.

Area of recorded infilled pond.

Alluvium was encountered in TP34 and TP35 in the vicinity of the Pennington Brook which may require foundation deepening or an alternative foundation solution required. It is unlikely that development is proposed in this area given the steep slope, existing footpath and brook.

D	AL	06/21	Updated Proposed
C	AL	05/21	TP101 - 115 added
B	JH	05/21	Updated Proposed
A	JH	04/21	Updated Proposed
Rev	Drawn	Date	Description

Drawing Status:
Information

Contract:

Fairways, Westhoughton

For: Bellway Homes (Manchester) Ltd

Drawing Title:

Indicative Foundation Zoning Plan

IGE
consulting

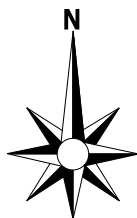
Suite 4, 14 - 32 Hewitt Street, Manchester, M15 4GB
Email: contact@igeconsulting.co.uk
Web: www.igeconsulting.co.uk
Tel: 0161 237 9310

Scale: 1:1750 @A3 Date: March 2021

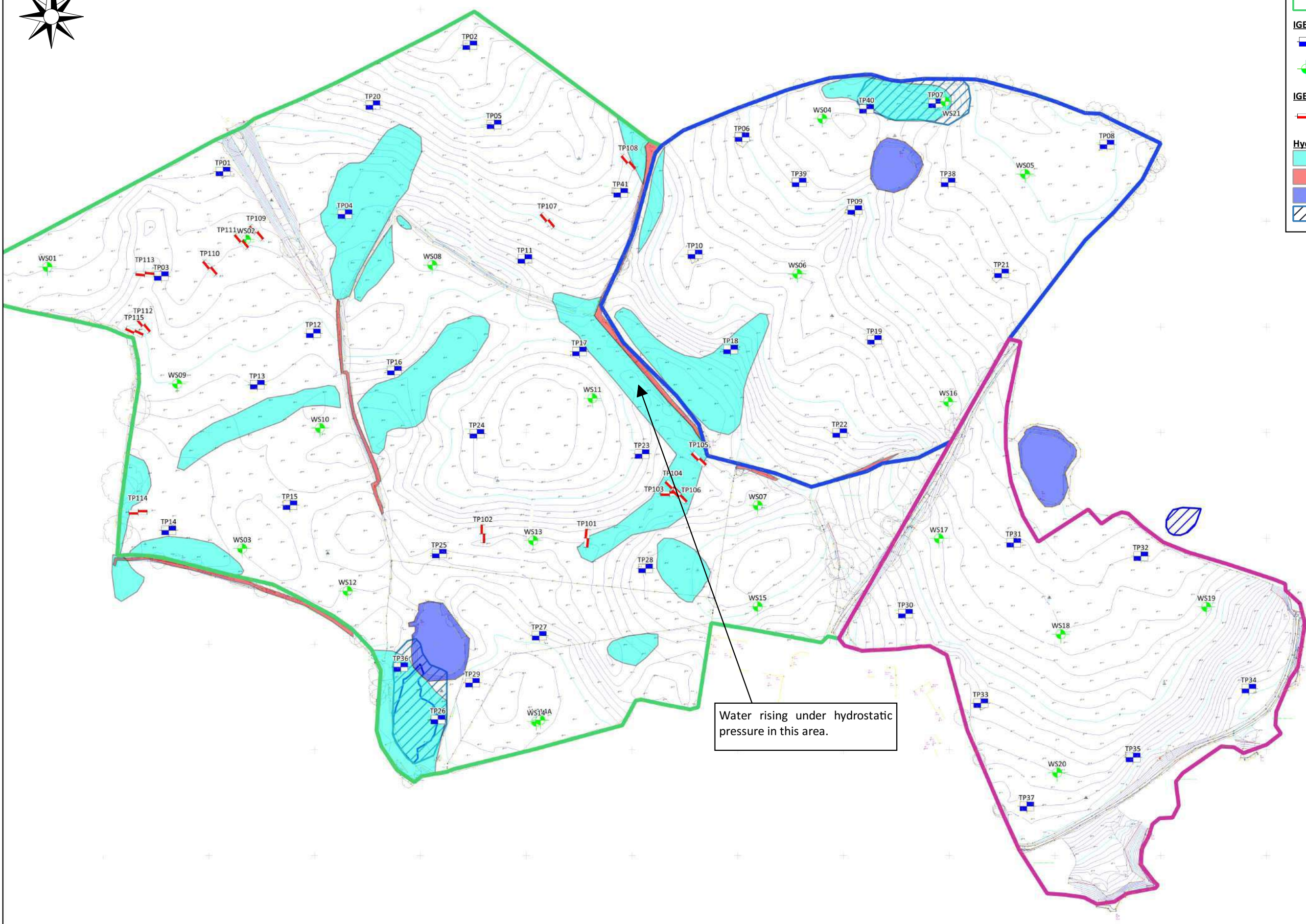
Drawn: AL Checked: AE

Contract No.	Drawing No.	
3430	SI-06	P2

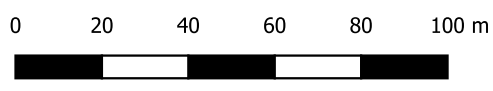
0 20 40 60 80 100 m



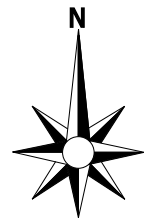
FOR GUIDANCE PURPOSES ONLY



- Development Phases**
- Development Phase 3
 - Development Phase 4
 - Development Phase 5
- IGE Site Investigation Works (February 2021)**
- Trial Pits
 - Window Sample Holes
- IGE GPR Trace Inspection Pits (May 2021)**
- Trial Pits
- Hydrological Features Noted in February 2021**
- Approximate Extent of Waterlogged Areas
 - Existing Drainage Runs
 - Existing Ponds
 - Suspected Infilled Ponds

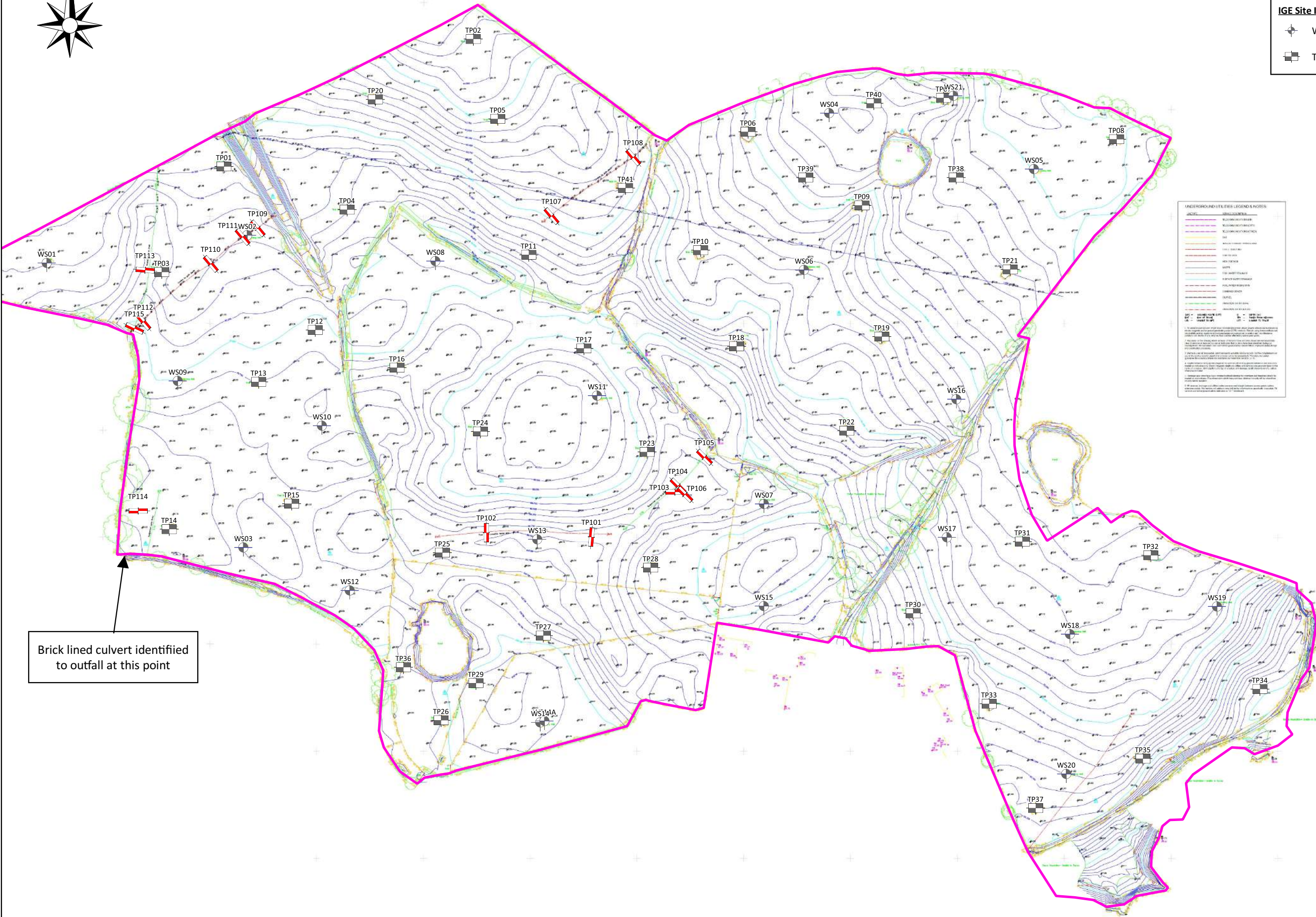


A	AL	05.21	TP101 - 115 added	
Rev	Drawn	Date	Description	
Drawing Status: Information				
Contract: Fairways, Westhoughton For: Bellway Homes (Manchester) Ltd				
Drawing Title: Indicative Hydrological Features Plan				
IGE consulting				
Suite 4, 14 - 32 Hewitt Street, Manchester, M15 4GB Email: contact@igeconsulting.co.uk Web: www.igeconsulting.co.uk Tel: 0161 237 9310				
Scale: 1:1750 @A3		Date: March 2021		
Drawn: AL		Checked: AE		
Contract No. 3430		Drawing No. SI-07		P1



FOR GUIDANCE PURPOSES ONLY

- Approximate Site Boundary
- IGE GPR Trace Inspection Pits (May 2021)
 - Trial Pits
- IGE Site Investigation Works (February 2021)
 - Window Sample Holes
 - Trial Pits



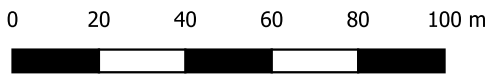
UNDERGROUND UTILITIES LEGEND & NOTES

1. The information on this map is derived from a combination of sources including aerial photography, ground surveys, and public records. It is not intended to be a definitive statement of the location or depth of any underground utilities. The user should exercise caution when interpreting this information and consult with the appropriate authorities for further details.

2. The information on this map is for guidance purposes only and should not be used as a basis for any design or construction work. The user should consult with the appropriate authorities for further details.

3. The information on this map is for guidance purposes only and should not be used as a basis for any design or construction work. The user should consult with the appropriate authorities for further details.

Brick lined culvert identified to outfall at this point



Rev	Drawn	Date	Description
Drawing Status: Information			
Contract: Fairways, Westhoughton			
For: Bellway Homes (Manchester) Ltd			
Drawing Title: Exploratory Hole Location Plan - Service Inspection Pits			
Suite 4, 14 - 32 Hewitt Street, Manchester, M15 4GB Email: contact@igeconsulting.co.uk Web: www.igeconsulting.co.uk Tel: 0161 237 9310			
Scale: 1:1750 @A3		Date: May 2021	
Drawn: AL		Checked: AE	
Contract No. 3430	Drawing No. SI-08	P1	

APPENDIX 3
PROPOSED DEVELOPMENT PLAN

ACCOMMODATION SCHEDULE - BELLWAY
OVERALL DEVELOPMENT

Name	Ref	Bed	Storey	Unit No's	Unit ft²	ft² Total
Private Housing						
Forester	FO-4B	4 Bed	2	20	1526	30520
Bowyer	BO-4B	4 Bed	2	13	1356	17628
Scrivener	SC-4B	4 Bed	2	26	1214	31564
Farrier	FA-4B	4 Bed	2	38	1171	44498
Sawyer	SY-3B	3 Bed	2	26	1092	28392
Mason	MA-3B	3 Bed	2	12	1059	12708
Lymer	LY-3B	3 Bed	2	33	986	32538
Thesplan	TH-3B	3 Bed	2	8	921	7368
Tailor	TA-3B	3 Bed	2	34	802	27268
Affordable Housing						
Thesplan	TH-3B	3 Bed	2	15	921	13815
Tailor	TA-3B	3 Bed	2	31	802	24862
Shoemaker	SH-3B	3 Bed	2	19	750	14250
Joiner	JO-2B	2 Bed	2	39	680	26520
Derby	DE-2B	2 Bed	ff	3	663	1989
York	YO-1B	1 Bed	ff	3	480	1440
Rydal	RY-1B	1 Bed	gf	3	537	1611
Grand Total:			323 Units		316971 ft²	

Gross Site Area: 14.08 ha 34.79 ac

Site Statistics:		
SSR	0.54 ha	1.33 ac
POS	3.58 ha	8.85 ac
Extended Gardens	0.21 ha	0.52 ac
Spine Road	0.74 ha	1.83 ac

Nett Site Area: 9.01 ha 22.25 ac

Gross Density: 22.94 Un/ha 9.28 Un/ac

Nett Density: 35.86 Un/ha 14.51 Un/ac

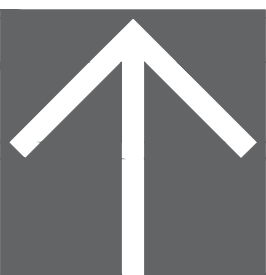
Gross Footage: 2091.45 m²/ha 9110.34 Un/ac

Nett Footage: 3269.78 m²/ha 14243.13 ft²/ac

*Note - All Areas Approx.
Abbreviations
Ac = Acres | ha = Hectares | ft² = Square Feet | m² = square | Un = units Metres | SSR = Single Sided Road | POS = Public Open Space | Det = Detached | Apt = Apartment | Int = Integral | Sgl = Single | Del = Double

Proposed Layout Key

- Red Edge Boundary extracted from Title Plan no. CH491619
- Plot Number
- Denotes Existing Buildings
- Dotted line either side of the existing water denotes an 8m stud off. Exact alignment to be determined
- Approximate tree canopy extracted from Master plan produced by GA Architects. Exact canopy and RPZ to be confirmed.
- Indicative landscaping - see landscaping proposals for further details
- Denotes Affordable dwelling



WESTHOUGHTON OVERALL
CAD SKETCH LAYOUT

Long Island Golf Course

Note:
Do not scale from this drawing
All contractors must visit the site and be responsible for taking and checking dimensions.
All construction information should be taken from figured dimensions only.
Any discrepancies between drawings, specifications and site conditions must be brought to the attention of the supervising officer.

This drawing is for planning purposes only. It is not intended to be used for construction purposes. Whilst all reasonable efforts are used to ensure drawings are accurate, Astle Planning and Design Ltd accept no responsibility or liability for any reliance placed on, or use made of, this plan by anyone for purposes other than those stated above.

Rev.	Date	Description	By	Chk
D	24.02.21	Survey brought into layout and overall scheme revised to address comments received from SGL Sub-Station added within phase 4 along spine road	AE	MP
C	22.02.21	Layout revised following comments received from client dated 21.02.21	AE	MP
B	17.02.21	Layout revised following comments received from client	RH/ AE	MP
A	04.02.21	Layout revised following comments received from client dated 02.02.21	AE	MP

Client



Project
WESTHOUGHTON OVERALL

Drawing Title
**DRAFT ISSUE
CAD SKETCH LAYOUT**

Drawn by AE Checked by MP Date 22.01.21

Status **SKETCH** Scale @ A1 NTS

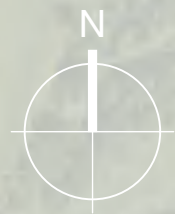
Job no. **BHM180** Dwg. no. **SK04** Rev. **D**

astle planning & design
The Steam Mill,
Steam Mill Street,
Chester,
CH3 5AN
01244 886644
info@astlepd.co.uk
www.astlepd.co.uk

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WESTHOUGHTON

Further Phases - Scheme Parameters



PHASE 5
Developable Area 5.84Ha/14.43Ac
C. 200 dwellings @35UpHa

PHASE 4
Developable Area 2.80Ha/6.92Ac
C. 95 dwellings @35UpHa

PHASE 1

PHASE 2

PHASE 3
Developable Area 1.73Ha/4.28Ac
C. 60 dwellings @35UpHa

MAIN ACCESS/
EGRESS

SECONDARY
ACCESS/EGRESS

APPENDIX 4
TRIAL PIT LOGS AND PHOTOGRAPHS

IGEconsulting Suite 4, 14-32 Hewitt St Manchester, M15 4GB email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk				Trial Pit Log ver. 1.1				Trial Pit No. TP01 Sheet 1 of 1			
Project Name: The Fairways					Level (mAOD): 91.43		Date: 03/02/2021		Project No. 3430		
Location: Westthoughton					Weather: Overcast				Logged By AL		
Client: Bellway Homes (Manchester) Ltd.					Co-ords: 364307E - 406023N				Checked By AJ		
Water Strike	Samples & In Situ Testing			Depth (mbgl)	Level (mAOD)		Stratum Description				
	Depth (m)	Type	Results								
	0.10	B	5kg	0.30	91.13		Dark brown, clayey SAND with frequent rootlets and occasional gravel. Gravel is rounded to subangular of fine to coarse red brick (10%) and mixed lithologies (90%). TOPSOIL				
							Soft to firm, light orangish brown, slightly sandy, silty CLAY with occasional gravel. Gravel is rounded to subrounded of fine to coarse mixed lithologies. GLACIAL TILL				
	0.60		HVP=46				Becoming firm from 0.60m bgl.				
	0.60		HVP=59								
	0.60		HVP=60				0.10m diameter ceramic land drain trending north to south encountered at 0.80m bgl.				
	0.90	B	5kg								
	0.90		HVP=53								
	0.90		HVP=58								
	0.90		HVP=70								
	1.20		HVP=33	1.30	90.13		Orangish brown, clayey SAND with rare gravel. Gravel is rounded to subrounded of fine to coarse mixed lithologies. GLACIAL TILL				
	1.20		HVP=45								
	1.20		HVP=50	1.60	89.83		Firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY with rare cobbles. Cobbles are subrounded to rounded of mixed lithologies. Gravel is subrounded to rounded of fine to coarse sandstone (40%), mudstone (20%), coal (10%) and mixed lithologies (30%). GLACIAL TILL				
	1.70		HVP=82				Becoming friable from 2.00m bgl.				
	1.70		HVP=90								
	1.70		HVP=92								
	1.90		HVP=119								
	1.90		HVP=62								
	1.90		HVP=65								
	2.20		HVP=107								
	2.20		HVP=120								
2.20		HVP=94									
2.40		HVP=114									
2.40		HVP=116									
2.40		HVP=120	2.70	88.73		Trial Pit terminated at 2.70m.					
Water Strike											
Depth Strike (mbgl)		Remarks									
		No strike.									
Stability: Stable											
Remarks: Trial Pit terminated at target depth.											

Trial Pit Photos

TP01

The Fairways



Image 1. TP01 Pit
TP01 Pit



Image 2. TP01 Spoil
TP01 Spoil

IGEconsulting Suite 4, 14-32 Hewitt St Manchester, M15 4GB email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk				Trial Pit Log ver. 1.1				Trial Pit No. TP02 Sheet 1 of 1				
Project Name: The Fairways					Level (mAOD): 94.63		Date: 02/02/2021		Project No. 3430			
Location: Westhoughton					Weather: Snow and rain				Logged By AL			
Client: Bellway Homes (Manchester) Ltd.					Co-ords: 364423E - 406083N				Checked By AJ			
Water Strike	Samples & In Situ Testing			Depth (mbgl)	Level (mAOD)		Stratum Description					
	Depth (m)	Type	Results									
	0.10	B	5kg				Dark brown, clayey SAND with frequent rootlets and occasional gravel. Gravel is subangular to well rounded of fine to coarse mixed lithologies. TOPSOIL					
				0.35	94.28		Firm, orangish brown, slightly sandy, silty CLAY with rare gravel. Gravel is subrounded to well rounded of fine to coarse sandstone (60%) and mixed lithologies (40%). GLACIAL TILL					
	0.60	B	5kg	0.70	93.92		Firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY. Gravel is rounded of fine to coarse sandstone (40%), coal (20%) and mixed lithologies (40%). GLACIAL TILL					
	0.60		HVP=47									
	0.60		HVP=47									
	0.60		HVP=50									
	1.00		HVP=102									
	1.00		HVP=75									
	1.00		HVP=80									
	1.30		HVP=72									
	1.30	HVP=75										
	1.30	HVP=90										
	1.70	HVP=80										
	1.70	HVP=84										
	1.70	HVP=94										
2.00	HVP=69											
2.00	HVP=76											
2.00	HVP=80											
			2.40	92.22		Trial Pit terminated at 2.40m.						
Water Strike												
Depth Strike (mbgl)		Remarks										
		No strike.										
Stability: Stable												
Remarks: Trial Pit terminated at target depth.												

Trial Pit Photos

TP02

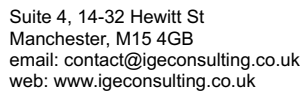
The Fairways



Image 1. TP02 Pit
TP02 Pit



Image 2. TP02 Spoil
TP02 Spoil



Trial Pit No.
TP03

Sheet 1 of 1

Project No.
3430

Logged By
AL

Checked By
AJ

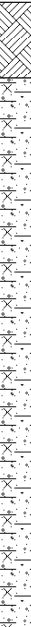
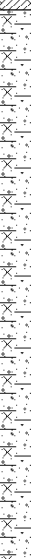
ver. 1.1

Level (mAOD):	90.58
---------------	-------

Project No.
3430

Logged By
AL

Checked By
AJ

Water Strike	Samples & In Situ Testing			Depth (mbgl)	Level (mAOD)			Stratum Description		
	Depth (m)	Type	Results							
				0.30	90.28			Dark brown, clayey SAND with frequent rootlets and occasional gravel. Gravel is subangular to well rounded of fine to coarse mixed lithologies. TOPSOIL		
	0.70	B	HVP=62						Firm to stiff, brown, slightly gravelly, silty CLAY with rare cobbles. Cobbles are subrounded to well rounded of mixed lithologies. Gravel is subrounded to well rounded of fine to coarse mudstone (40%), sandstone (30%), coal (10%) and mixed lithologies (20%). GLACIAL TILL	
	0.70		HVP=64							
	0.70		HVP=80							
	0.80		5kg							
	1.10		HVP=74							
	1.10		HVP=82							
	1.10		HVP=88							
	1.40		HVP=62							
	1.40		HVP=65							
	1.40		HVP=86							
	2.00		HVP=120							
	2.00		HVP=120							
	2.00		HVP=120							
	2.30	HVP=120								
	2.30	HVP=120								
	2.30	HVP=120								
				2.50	88.08				Trial Pit terminated at 2.50m.	
								</		

[illegible]

Trial Pit Photos

TP03

The Fairways



Image 1. TP03 Pit
TP03 Pit



Image 2. TP03 Spoil
TP03 Spoil

IGEconsulting Suite 4, 14-32 Hewitt St Manchester, M15 4GB email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk				Trial Pit Log ver. 1.1				Trial Pit No. TP04 Sheet 1 of 1			
Project Name: The Fairways					Level (mAOD): 91.00		Date: 02/02/2021		Project No. 3430		
Location: Westhoughton					Weather: Snow and rain				Logged By AL		
Client: Bellway Homes (Manchester) Ltd.					Co-ords: 364364E - 406003N				Checked By AJ		
Water Strike	Samples & In Situ Testing			Depth (mbgl)	Level (mAOD)		Stratum Description				
	Depth (m)	Type	Results								
	0.20	B	5kg	0.30	90.70		Soft, dark brown, sandy CLAY with frequent rootlets and occasional gravel. Gravel is rounded of fine to coarse mixed lithologies. TOPSOIL				1 2 3 4 5
	0.50		HVP=25		Soft to firm, light orangish brown, sandy CLAY with occasional gravel. Gravel is rounded of fine to coarse mixed lithologies. GLACIAL TILL						
	0.50		HVP=26								
	0.50		HVP=30								
	0.70		HVP=27								
	0.70		HVP=28								
	0.70	HVP=30									
	1.30	B	5kg	1.10	89.90		Orangish brown, clayey SAND with occasional gravel. Gravel is rounded of fine to coarse mixed lithologies. GLACIAL TILL				
	1.60		89.40		Stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY with occasional cobbles. Cobbles are rounded to well rounded of mixed lithologies. Gravel is rounded to subrounded of fine to coarse mixed lithologies. GLACIAL TILL						
	1.70		HVP=71								
	1.70		HVP=72								
	1.70		HVP=76								
	1.90		HVP=110								
	1.90		HVP=89								
	2.20		HVP=74								
2.20	HVP=78										
2.20	HVP=88	2.30	88.70	Trial Pit terminated at 2.30m.							
Water Strike											
Depth Strike (mbgl)		Remarks									
		No strike.									
Stability: Stable											
Remarks: Trial Pit terminated at target depth.											

Trial Pit Photos

TP04

The Fairways



Image 1. TP04 Pit
TP04 Pit



Image 2. TP04 Spoil
TP04 Spoil

IGEconsulting Suite 4, 14-32 Hewitt St Manchester, M15 4GB email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk				Trial Pit Log ver. 1.1				Trial Pit No. TP05 Sheet 1 of 1					
Project Name: The Fairways						Level (mAOD): 93.79		Date: 02/02/2021		Project No. 3430			
Location: Westhoughton						Weather: Snow and rain				Logged By AL			
Client: Bellway Homes (Manchester) Ltd.						Co-ords: 364435E - 406046N				Checked By AJ			
Water Strike	Samples & In Situ Testing			Depth (mbgl)	Level (mAOD)		Stratum Description						
	Depth (m)	Type	Results										
				0.35	93.44		Soft, dark brown, sandy CLAY with frequent rootlets and rare gravel. Gravel is subangular to well rounded of fine to coarse mixed lithologies. TOPSOIL						
							Firm, brown, slightly sandy, silty CLAY with occasional gravel. Gravel is rounded of fine to coarse mixed lithologies. GLACIAL TILL						
	0.80		HVP=48				With rare cobbles from 0.90m bgl. Cobbles are well rounded of granite.						1
	0.80		HVP=52										
	0.80		HVP=61										
	1.10		HVP=70										
	1.10		HVP=76										
				1.00	92.79		Firm to stiff, brown, mottled grey, slightly gravelly, slightly sandy, silty CLAY with rare cobbles. Cobbles are rounded of mixed lithologies. Gravel is subrounded to well rounded of fine to coarse sandstone (50%), coal (10%) and mixed lithologies (40%). GLACIAL TILL						
													2
	1.10		HVP=79										
	1.30		HVP=102										
	1.30		HVP=70										
	1.30		HVP=98										
				1.80	91.99		Brown, clayey SILT with occasional gravel and rare boulders. Boulders are rounded of sandstone. Gravel is rounded to well rounded of fine to coarse sandstone (60%) and mixed lithologies (40%). GLACIAL TILL						
							Trial Pit terminated at 2.40m.						3
1.70		HVP=102											
1.70		HVP=89											
1.70		HVP=98											
2.00	B	5kg											
			2.40	91.39									
												4	
												5	
Water Strike													
Depth Strike (mbgl)		Remarks											
		No strike.											
Stability:													
Stable													
Remarks:													
Trial Pit terminated at target depth.													